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User's manual
ACB530

12/12 **Installation & Operating Manual** MN796-ACB530

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Chapter 1
Introduction

1.1 Manual Introduction

1.1.1 What This Chapter Contains

This chapter contains introductory information related to the ACB530 variable frequency drive. This drive provides functionality that can be used to control many variable speed applications.
This manual contains information on:

- Delivery inspection
- Safety instructions (put in after delivery)
- Installing and wiring the ACB530 drive
- Programming the drive
- References related to manuals

The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

The manual is intended for both US and global use.

1.1.2 Applicable Firmware Versions

The manual is applicable to the ACB530 drive firmware version **XXXXX** or later. See Parameter 3301 Firmware to confirm.

1.1.3 Purpose of the Manual

This manual provides information needed for planning the installation, installing, start-up, operating and servicing the drive.

1.1.4 Related Documents

See List of related manuals on page 2 (inside of the front cover).

1.1.5 Categorization by Frame Size

The ACB530 is manufactured in frame sizes R1 through R6. Frame site specific information is identified in this manual with the text R1 through R6. To identify the frame size of your drive, see the table in section Ratings.

1.2 Safety Notices

This equipment contains voltages that may be as high as 1000 volts! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment. This equipment may be connected to other machines that have rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

1.3 Use of Warnings

Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment, and advise on how to avoid the danger. The following types of warnings are used in this manual:

Electricity warning warns of hazards from electricity which can cause physical injury and/or damage to the equipment.

General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.

1.4 Safety Related to Installation and Maintenance

These warnings are intended for anyone who works on the drive, power cables or motor.

1.4.1 Electrical Safety

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment.

Only qualified electricians are allowed to install and maintain the drive!

- **Never work on the drive, power cables or motor when input power is applied. After disconnecting the input power, always wait for 5 minutes to let the internal circuit capacitors discharge before you start working on the drive, motor or power cables.**

Always ensure by measuring with a multimeter (impedance at least 1 Mohm) that
1. **there is no voltage between the drive input phases U1, V1 and W1 and the ground**
2. **there is no voltage between terminals BRK+ and BRK- and the ground.**

- **Do not work on the control cables when power is applied to the drive or to the external control circuits. Externally supplied control circuits may carry dangerous voltage even when the input power of the drive is switched off.**
- **Do not make any insulation or voltage withstand tests on the drive.**
- **Disconnect the internal EMC fi lter when installing the drive on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system), otherwise the system will be connected to ground potential through the EMC filter capacitors. This may cause danger or damage the drive.**
- **Note: When the internal EMC fi lter is disconnected, the drive is not EMC compatible without an external fi lter.**
- **Disconnect the internal EMC fi lter when installing the drive on a corner-grounded TN system, otherwise the drive will be damaged.**
  Note: When the internal EMC fi lter is disconnected, the drive is not EMC compatible without an external filter.
- **All ELV (extra low voltage) circuits connected to the drive must be used within a zone of equipotential bonding, i.e. within a zone where all simultaneously accessible conductive parts are electrically connected to prevent hazardous voltages appearing between them. This is accomplished by a proper factory grounding.**

Note:
- Even when the motor is stopped, dangerous voltage is present at the power circuit terminals U1, V1, W1 and U2, V2, W2 and BRK+ and BRK-.

Before installation and maintenance work on the drive:
• Stop the motor.
• Ensure that there is no voltage on the drive power terminals according to step 1 or 2, or if possible, according to the both steps.
1. **Disconnect the motor from the drive with a safety switch or by other means. Measure that there is no voltage present on the drive input or output terminals (U1, V1, W1, U2, V2, W2, BRK+, BRK-).**
2. **Ensure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, is able to rotate the motor directly or through any mechanical connection like felt, nip, rope, etc. Measure that there is no voltage present on the drive input or output terminals (U1, V1, W1, U2, V2, W2, BRK+, BRK-). Ground the drive output terminals temporarily by connecting them together as well as to the PE.**

1.4.2 General Safety

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment.

- **The drive is not field repairable. Never attempt to repair a malfunctioning drive; contact your local Baldor representative or Authorized Service Center for replacement.**
- **Make sure that dust from drilling does not enter the drive during the installation. Electrically conductive dust inside the drive may cause damage or lead to malfunction.**
- **Ensure sufficient cooling.**

1.5 Unpacking

The drive is delivered in a package that also contains the following items (frame size R1 shown in the figure below):

- assistant keypad (not shown)
- mounting template,
- user's manual

Lift the drive only by the metal chassis.

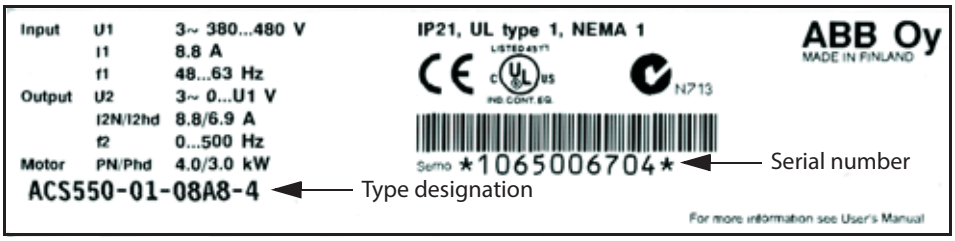
1.6 Inspection

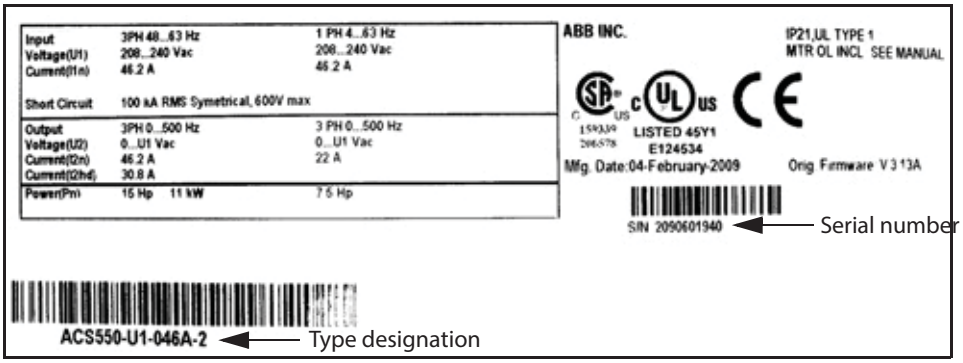
Check that there are no signs of damage. Notify the shipper immediately if damanged components are found.

Before attempting installation and operation, check the information on the type designation label of the drive to verify that the drive is of the correct type. See section Type Designation Label.

1.7 Type Designation Label

The type designation label is attached to the left side of the drive. An example label and explanation of the label contents are shown below.





1.7.1 Serial Number Explanation

The format of the drive serial number shown on the labels is described below.

Serial number is of format CYYWWXXXXX, where

C:	Country of manufacture
YY:	Year of manufacture
WW:	Week of manufacture; 01, 02, 03, ... for week 1, week 2, week 3
XXXXX:	Integer starting every week from 00001

1.8 Safe Start-Up and Operation

These warnings are intended for all who plan the operation, start up or operate the drive.

1.8.1 Electrical Safety

WARNING! It is not recommended to run the permanent magnet synchronous motor over 1.2 times the rated speed. Motor overspeed may lead to overvoltage which may permanently damage the drive.

1.8.2 General Safety

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment.

- **Before adjusting the drive and putting it into service, make sure that the motor and all driven equipment are suitable for operation throughout the speed range provided by the drive. The drive can be adjusted to operate the motor at speeds above and below the speed provided by connecting the motor directly to the power line.**
- **Do not activate automatic fault reset functions if dangerous situations can occur. When activated, these functions will reset the drive and resume operation after a fault.**
- **Do not control the motor with an AC contactor or disconnecting device (disconnecting means); use instead the keypad start and stop keys and or external commands (I/O or fieldbus). The maximum allowed number of charging cycles of the DC capacitors (ie power-ups by applying power) is 5 in 10 minutes.**
- **Even when power is switched off from the input terminals of the ACB530, there may be dangerous voltage (from external sources) on the terminals of the relay outputs RO1 through RO3.**
- **When the control terminals of two or more drives are connected in parallel, the auxiliary voltage for these control connections must be taken from a single source which can either be one of the drives or an external supply.**
- **Do not attempt to install or remove EM1, EM3, F1 or F2 screws while power is applied to the drive's input terminals.**
- **The ACB530-01/U1 is not field repairable. Never attempt to repair a malfuctioning drive; contact your local Baldor representative for replacement.**
- **The ACB530 will start up automatically after an input voltage interruption if the external run command is on.**
- **The heat sink may reach a high temperature. See informtion on Technical data.**

Note:

- **When the control location is not set to local (LOC not shown on the display), the stop key on the keypad will not stop the drive. To stop the drive using the keypad, first press the LOC/REM key.**

1.9 Terms and Abbreviations

Term/abbreviation	Explanation
ACB-CP-BA	Assistant keypad, advanced operator keypad for communication with the drive
Brake chopper	Conducts the surplus energy from the intermediate circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor.
Brake resistor	Dissipates the drive surplus braking energy conducted by the brake chopper to heat. Essential part of the brake circuit. See Brake chopper.
Capacitor bank	See DC link capacitors.
Control board	Circuit board in which the control program runs.
CRC	Cyclic redundancy check
DC link	DC circuit between rectifier and inverter
DC link capacitors	Energy storage which stabilizes the intermediate circuit DC voltage.
DCU	Drive control unit
Drive	Frequency converter for controlling AC motors
EMC	Electromagnetic compatibility
EFB	Embedded fieldbus
FBA	Fieldbus adapter
FCAN	Optional CANopen adapter module
FDNA	Optional DeviceNet adapter module

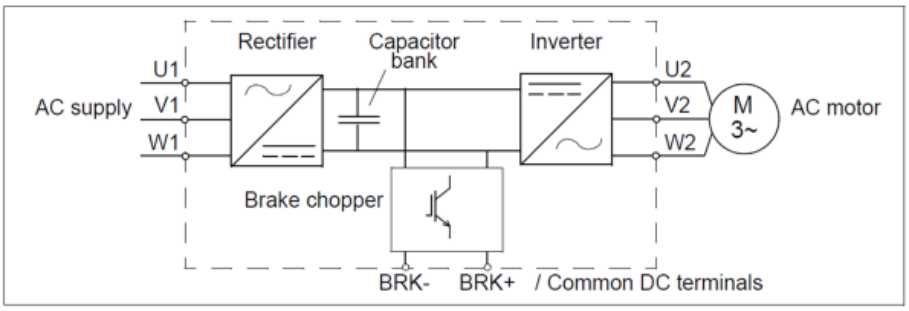
Term/abbreviation	Explanation
FECA	Optional EtherCAT adapter module
FENA	Optional Ethernet adapter module for EtherNet/IP, Modbus TCP and PROFINET IO protocols
FMBA	Optional Modbus RTU adapter module
FPBA	Optional PROFIBUS DP adapter module
Frame (size)	Refers to drive physical size, for example R1 and R2. To determine the frame size of a drive, refer to the rating table in chapter Technical data.
FRSA	RSA-485 adapter board
I/O	Input/Output
ID run	Identification run
IGBT	Insulated gate bipolar transistor
Intermediate circuit	See DC link.
Inverter	Converts direct current and voltage to alternating current and voltage.
IT system	Type of supply system that has no (low-impedance) connection to ground/earth.
LRFI	Series of optional EMC filters
LSW	Least significant word
Macro	Pre-defined default values of parameters in drive control program. Each macro is intended for a specific application. See Parameter.
MPOT	Potentiometer module
MPOW	Auxiliary power extension module
MSW	Most significant word
MUL1-R1	Option kit for R1 frame sizes for compliance with NEMA 1
MUL1-R3	Option kit for R3 frame sizes for compliance with NEMA 1
MUL1-R4	Option kit for R4 frame sizes for compliance with NEMA 1
Parameter	User-adjustable operation instruction to the drive, or signal measured or calculated by the drive
PLC	Programmable logic controller
PMSM	Permanent magnet synchronous motor
PROFIBUS, PROFIBUS DP, PROFINET IO	Registered trademarks of PI - PROFIBUS & PROFINET International
R1, R2, ...	Frame (size)
RCD	Residual current device
Rectifier	Converts alternating current and voltage to direct current and voltage.
RFI	Radio-frequency interference
RTU	Remote terminal unit
SIL	Safety integrity level. See Appendix: Safe torque off (STO).
STO	Safe torque off. See Appendix: Safe torque off (STO).
TN system	Type of supply system that provides a direct connection to ground/earth.

1.10 Operation Principle and Hardware Description

1.10.1 Operation Principle

The ACB530 is a wall or cabinet mountable drive for controlling asynchronous AC induction motors and permanent magnet synchronous motors.

The figure below shows the simplified main circuit diagram of the drive. The rectifier converts three-phase AC voltage to DC voltage. The capacitor bank of the intermediate circuit stabilizes the DC voltage. The inverter converts the DC voltage back to AC voltage for the AC motor. The brake chopper connects the external brake resistor to the intermediate DC circuit when the voltage in the circuit exceeds its maximum limit.

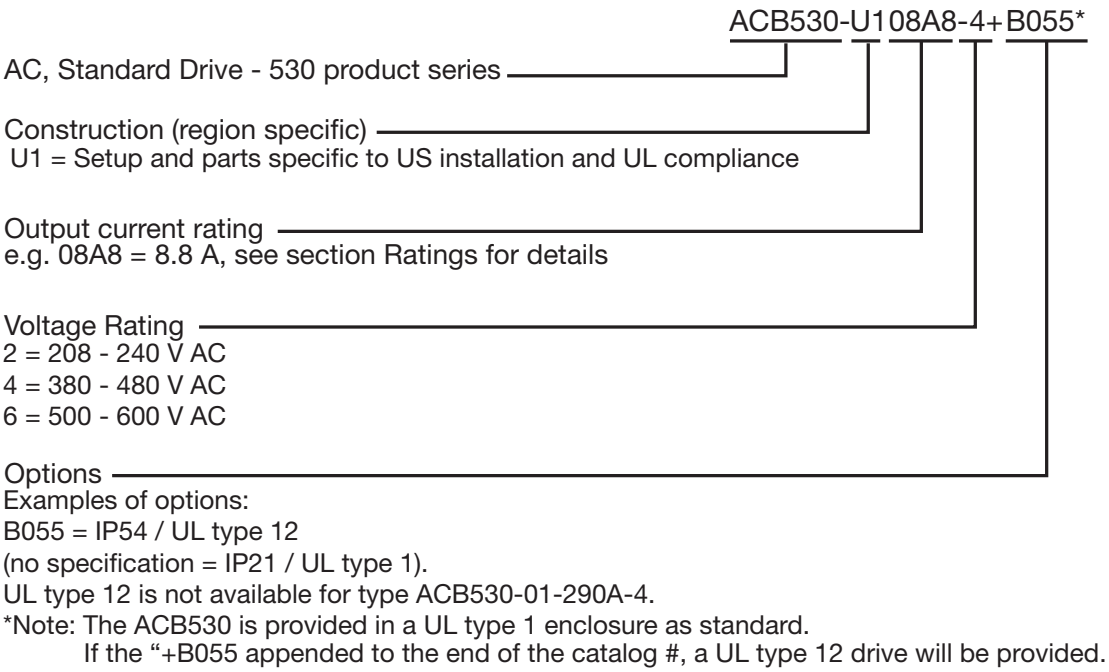


Chapter 2
General Information and Ratings

2.1 Type Designation

Use the following chart to interpret the type designation found on both the type designation and the serial number label.

Figure 2-1


ACB530-U108A8-4+B055*
AC, Standard Drive - 530 product series
Construction (region specific)
U1 = Setup and parts specific to US installation and UL compliance
Output current rating
e.g. 08A8 = 8.8 A, see section Ratings for details
Voltage Rating
2 = 208 - 240 V AC
4 = 380 - 480 V AC
6 = 500 - 600 V AC
Options
Examples of options:
B055 = IP54 / UL type 12
(no specification = IP21 / UL type 1).
UL type 12 is not available for type ACB530-01-290A-4.
*Note: The ACB530 is provided in a UL type 1 enclosure as standard.
If the "+B055 appended to the end of the catalog #, a UL type 12 drive will be provided.

1) The ACB530 is compatible with keypads that have the following revisions.

Keypad Type	Type code	Keypad Revision	Keypad Firmware
Assistant Keypad	ACB-CP-BA	For later	2.04 or later

2.1.1 Serial Number

The format of the drive serial number shown on the labls is described below.

Serial number is of format CYYWWXXXXX, where
C: Country of manufacture
YY: Year of manufacture
WW: Week of manufacture: 01, 02, 03, - for week 1, week 2, week 3, etc.
XXXXX: Integer starting every week from 00001.

2.1.1 Ratings and Frame Size

The tables below lists technical specifications and identifies the drive's frame size — significant, since some instructions in this document vary, depending on the drive's frame size. To read the ratings table, you need the "Output current rating" entry from the type designation. Also, when using the ratings table, note that the table is broken into sections based on the drive's "Voltage rating".

By type designation, the table below provides ratings for the ACB530 adjustable speed AC drive, including:

- IEC ratings
- NEMA ratings (shaded columns)
- frame size.

Table 2-1 Ratings, 208 - 240V Drives

Abbreviated column headers are described in section Symbols.

Type	Normal use			Heavy-duty use			Frame Size
ACB530-U1- see below	I_{2N} A	P_N kW	P_N hp	I_{2hd} A	P_{hd} kW	P_{hd} hp	
Three-phase supply voltage, 208 - 240V							
-07A5-2	7.5	1.5	2	6.6	1.1	1.5	R1
-012A-2	11.8	2.2	3	7.5	1.5	2	R1
-017A-2	16.7	4	5	11.8	2.2	3	R1
-024A-2	24.2	5.5	7.5	16.7	4	5	R2
-031A-2	30.8	7.5	10	24.2	5.5	7.5	R2
-046A-2	46.2	11	15	30.8	7.5	10	R3
-059A-2	59.4	15	20	46.2	11	15	R3
-075A-2	74.8	18.5	25	59.4	15	20	R4
-088A-2	88.0	22	30	74.8	18.5	25	R4
-114A-2	114	30	40	88.0	22	30	R4
-143A-2	143	37	50	114	30	40	R6
-178A-2	178	45	60	150	37	50	R6
-221A-2	221	55	75	178	45	60	R6
-248A-2	248	75	100	192	55	75	R6

Table 2-2 Ratings, 380 - 480V Drives

Abbreviated column headers are described in section Symbols.

Type	Normal use			Heavy-duty use			Frame Size
ACB530-U1- see below	I_{2N} A	P_N kW	P_N hp	I_{2hd} A	P_{hd} kW	P_{hd} hp	
Three-phase supply voltage, 380 - 480V							
-04A1-4	4.1	1.5	2	3.3	1.1	1.5	R1
-05A4-4	5.4	2.2	Note 1	4.1	1.5	Note 1	R1
-06A9-4	6.9	3	3	5.4	2.2	3	R1
-08A8-4	8.8	4	5	6.9	3	3	R1
-012A-4	11.9	5.5	7.5	8.8	4	5	R1
-015A-4	15.4	7.5	10	11.9	5.5	7.5	R2
-023A-4	23	11	15	15.4	7.5	10	R2
-031A-4	31	15	20	23	11	15	R3
-038A-4	38	18.5	25	31	15	20	R3
-045A-4	45	22	30	38	18.5	25	R3
-059A-4	59	30	40	44	22	30	R4
-072A-4	72	37	50	59	30	40	R4
-078A-4	77	Note 2	60	72	Note 2	50	R4
-087A-4	87	45	Note 1	72	37	Note 1	R4
-097A-4	97	Note 2	75	77	Note 2	60	R4
-125A-4	125	55	Note 1	87	45	Note 1	R5
-125A-4	125	Note 2	100	98	Note 2	75	R5
-157A-4	157	75	125	124	55	100	R6
-180A-4	180	90	150	156	75	125	R6
-195A-4	205	110	Note 1	162	90	Note 1	R6
-246A-4	246	132	200	192	110	150	R6
-290A-4	290	160	Note 1	246	132	200	R6

1. Not available in ACB530-U1 series.
2. Not available in ACB530-01 series.

Table 2-3 Ratings, 500 - 600V Drives

Abbreviated column headers are described in section Symbols.

Type	Normal use			Heavy-duty use			Frame Size
ACB530-U1- see below	I_{2N} A	P_N kW	P_N hp	I_{2hd} A	P_{hd} kW	P_{hd} hp	
Three-phase supply voltage, 500 - 600V (Note 1)							
-02A7-6	2.7	1.5	2	2.4	1.1	1.5	R2
-03A9-6	3.9	2.2	3	2.7	1.5	2	R2
-06A1-6	6.1	4	5	3.9	2.2	3	R2
-09A0-6	9.0	5.5	7.5	6.1	4	5	R2
-011A-6	11	7.5	10	9.0	5.5	7.5	R2
-017A-6	17	11	15	11	7.5	10	R2
-022A-6	22	15	20	17	11	15	R3
-027A-6	27	18.5	25	22	15	20	R3
-032A-6	32	22	30	27	18.5	25	R4
-041A-6	41	30	40	32	22	30	R4
-052A-6	52	37	50	41	30	40	R4
-062A-6	62	45	60	52	37	50	R4
-077A-6	77	55	75	62	45	60	R6
-099A-6	99	75	100	77	55	75	R6
-125A-6	125	90	125	99	75	100	R6
-144A-6	144	110	150	125	90	125	R6

1. Not available in ACB530-01 series.

2.1.1.1 Definitions

Typical ratings:

Normal use (10% overload capability)

I_{2N} continuous rms current. 10% overload is allowed for one minute in ten minutes.

P_N typical motor power in normal use. The kilowatt power ratings apply to most IEC, 4-pole motors. The horsepower ratings apply to most 4-pole NEMA motors.

Heavy-duty use (50% overload capability)

I_{2hd} continuous rms current. 50% overload is allowed for one minute in ten minutes.

P_{hd} typical motor power in heavy duty use. The kilowatt power ratings apply to most IEC, 4-pole motors. The horsepower ratings apply to most 4-pole NEMA motors.

2.1.1.2 Sizing

The current ratings are the same regardless of the supply voltage within one voltage range. To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. Also note that:

- the ratings apply for ambient temperature of 40°C (104°F)
- the maximum allowed motor shaft power is limited to $1.5 \cdot P_{hd}$. If the limit is exceeded, motor torque and current are automatically restricted. The function protects the input bridge of the drive against overload.

In multimotor systems, the output current of the drive must be equal to or greater than the calculated sum of the input currents of all motors.

2.1.1.1 Derating

The load capacity (current and power) decreases for certain situations, as defined below. In such situations, where full motor power is required, oversize the drive so that the derated value provides sufficient capacity.

For example, if your application requires 15.4 A of motor current and a 8 kHz switching frequency, calculate the appropriate drive size requirement as follows:

The minimum size required = 15.4 A / 0.80 = 19.25 A
Where: 0.80 is the derating for 8 kHz switching frequency (see section Switching frequency derating).

Referring to I_{2N} in the ratings tables, the following drives exceed the I2N requirement of 19.25 A: ACB530-x1-023A-4, or ACB530-x1-024A-2.

Temperature Derating

In the temperature range +40°C - 50°C (+104°F - 122°F), the rated output current is decreased 1% for every 1°C (1.8°F) above +40°C (+104°F). Calculate the output current by multiplying the current given in the rating table by the derating factor.

Example If the ambient temperature is 50°C (+122°F), the derating factor is 100% - 1%/°C · 10°C=90% or 0.90. The output current is then 0.90 · I_{2N} or 0.90 · I_{2hd}.

Altitude Derating

In altitudes 1000 - 4000m (3300 - 13,200ft) above sea level, the derating is 1% for every 100m (330ft). If the installation site is higher than 2000m (6600ft) above sea level, contact your local Baldor District Office for further information.

Single Phase Supply Derating

For 208 - 240 V series drives, a single phase supply can be used. In that case, the derating is 50%.

Switching Frequency Derating

When using the 8 kHz switching frequency (parameter 2606),
- derate all rated currents and powers (including drive's overload currents) to 80%.

When using the 12 kHz switching frequency (parameter 2606),
- derate all rated currents and powers (including drive's overload currents) to 65% (to 50% for 600 V, R4 frame sizes, that is for ACB530-U1-032A-6 - ACB530-U1-062A-6),
- derate ambient temperature maximum to 30°C (86°F).
- **Note:** The continuous maximum current is limited to I_{2hd}.

Note: Setting parameter 2607 SWITCH FREQ CTRL = 1 (ON) allows the drive to reduce the switching frequency if/when the drive's internal temperature exceeds 80°C (with 12kHz switching frequency) or 90°C (with 8kHz switching frequency). See the parameter description for 2607 for details.

2.2 Degrees of Protection

Available enclosures:
- IP21 / UL type 1 enclosure. The site must be free of airborne dust, corrosive gases or liquids, and conductive contaminants such as condensation, carbon dust and metallic particles.
- IP54 / UL type 12 enclosure. This enclosure provides protection from airborne dust and light sprays or splashing water from all directions.
  Note: UL type 12 enclosure is not available for type ACB530-01-290A-4.

Compared to the IP21 / UL type 1 enclosure, the IP54 / UL type 12 enclosure has:
- the same internal plastic shell as the IP21 enclosure
- a different outer plastic cover
- an additional internal fan to improve cooling
- larger dimensions
- the same rating (does not require a derating).

Chapter 3
Installing the Drive

3.1 Mechanical Installation

3.1.1 What This Chapter Contains

The chapter tells how to check the installation site, inspect the drive and install the drive mechanically.

3.1.2 Checking the Installation Site

The drive may be installed on the wall or in a cabinet.

The drive must be installed in an upright position.
Check the installation site according to the requirements below. Refer to the following pages for dimension drawings of drives.

3.1.3 Requirements for the Installation Site

It is important to ensure that the drive's environment and operating conditions comply with the drive specifications. The area behind the drive must be kept clear of all control and power wiring. Power connections may create electromagnetic fields that may interfere with control wiring or components when run in close proximity to the drive.

Read the recommendations in the following sections before continuing with the drive installation.

3.1.4 Location Instructions

Before deciding on an installation site, consider the following guidelines:
- Protect the cooling fan by avoiding dust or metallic particles.
- Do not expose the drive to a corrosive atmosphere.
- Protect the drive from moisture and direct sunlight.
- Verify that the drive location will meet the environmental conditions specified in Table 3-1.

Table 3-1 ACB530 Ambient Environment Requirements

	Installation Site	Storage and Transportation in the Protective Package
Altitude	• 0 - 1000m (0 - 3300ft) • 1000 - 2000m (3300 - 6600ft) if P_N and I_{2N} derated 1% every 100m above 1000m (300ft above 3300ft)	
Ambient Temperature	• Min. -15°C (5°F) – no frost allowed • Max. (fsw = 1 or 4) 40°C (104°F);50°C (122°F) if P_N and I_{2N} derated to 90% • Max. (fsw = 8) 40°C (104°F) if P_N and I_{2N} derated to 80% • Max. (fsw = 12) 30°C (86°F) if P_N and I_{2N} derated to 65% (to 50% for 600V, R4 frame sizes, that is for ACB530-U1-032A-6 - ACB530-U1-062A-6)	-40 - 70°C (-40 - 158°F)
Relative Humidity	5 - 95%, non-condensing	

3.1.5 Confirm that the enclosure is appropriate, based on the site contamination level:

- IP21 / UL type 1 enclosure: The site must be free of airborne dust, corrosive gases or liquids, and conductive contaminants such as dripping water, condensation, carbon dust and metallic particles.
- IP54 / UL type 12 enclosure: This enclosure provides protection from airborne dust and light sprays or splashing water from all directions.
- If, for some reason, an IP21 drive needs to be installed without the conduit box or cover, or an IP54 drive without the conduit plate or hood, see the note in chapter Technical data.

3.1.6 Confirm that the mounting location meets the following guidelines:

- The drive must be mounted vertically on a smooth, solid surface, and in a suitable environment as defined above. For horizontal installation, contact your local Baldor District Office for more information.
- The minimum space requirements for the drive are the outside dimensions (see section Dimensions and Weights), plus air flow space around the drive (see section Watts-Loss below).
- The distance between the motor and the drive is limited by the maximum motor cable length. See section Motor connection specifications.
- The mounting site must support the drive's weight. See section Weight.

3.2 Tools Required

To install the drive you need the following tools:

- screwdrivers (as appropriate for the mounting hardware used)
- wire stripper
- tape measure
- drill (if the drive will be installed with screws/bolts)
- mounting hardware: screws or bolts (if the drive will be installed with screws/bolts). For the number of screws/bolts, see Section Prepare to Mount the Drive.

3.3 Watts-Loss Data

Table 3-2 Cooling Specifications

Method	Internal fan, flow direction from bottom to top.
Requirement	Free space above and below the ACB530 drive: 200mm (8 in.) Free space is not required on the drive's sides - ACB530 drives can be mounted side-by-side

Table 3-3 Air Flow, 208 - 240V Drives

The following table lists heat loss and air flow data for 208-240V drives.

Drive		Heat Loss		Air Flow	
ACB530-U1-	**Frame Size**	**W**	**BTU/hr**	**m^3/h**	**ft^3/min**
-07A5-2	R1	81	276	44	26
-012A-2	R1	118	404	44	26
-017A-2	R1	161	551	44	26
-024A-2	R2	227	776	88	52
-031A-2	R2	285	973	88	52
-046A-2	R3	420	1434	134	79
-059A-2	R3	536	1829	134	79
-075A-2	R4	671	2290	280	165
-088A-2	R4	786	2685	280	165
-114A-2	R4	1014	3463	280	165
-143A-2	R6	1268	4431	405	238
-178A-2	R6	1575	5379	405	238
-221A-2	R6	1952	6666	405	238
-248A-2	R6	2189	7474	405	238

Table 3-4 Air Flow, 380 - 480V Drives

The following table lists heat loss and air flow data for 380-480V drives.

Drive		Heat Loss		Air Flow	
ACB530-U1-	Frame Size	W	BTU/hr	m^3/h	ft^3/min
-04A1-4	R1	52	178	44	26
-05A4-4	R1	73	249	44	26
-06A9-4	R1	97	331	44	26
-08A8-4	R1	127	434	44	26
-012A-4	R1	172	587	44	26
-015A-4	R2	232	792	88	52
-023A-4	R2	337	1151	88	52
-031A-4	R3	457	1561	134	79
-038A-4	R3	562	1919	134	79
-045A-4	R3	667	2278	134	79
-059A-4	R4	907	3098	280	165
-072A-4	R4	1120	3825	280	165
-078A-4	R4	1295	4423	250	147
-087A-4	R4	1440	4918	280	165
-097A-4	R4	1440	4918	280	165
-125A-4	R5	1940	6625	350	205
-157A-4	R6	2310	7889	405	238
-180A-4	R6	1810	9597	405	238
-195A-4	R6	3050	10416	405	238
-246A-4	R6	3260	11134	405	238
-290A-4	R6	3850	13125	405	238

Table 3-5 Air Flow, 500 - 600V Drives

The following table lists heat loss and air flow data for 500-600V drives.

Drive		Heat Loss		Air Flow	
ACB530-U1-	Frame Size	W	BTU/hr	m^3/h	ft^3/min
-02A7-6	R2	52	178	88	52
-03A9-6	R2	73	249	88	52
-06A1-6	R2	127	434	88	52
-09A0-6	R2	172	587	88	52
-011A-6	R2	232	792	88	52
-017A-6	R2	337	1151	88	52
-022A-6	R3	457	1561	134	79
-027A-6	R3	562	1919	134	79
-032A-6	R4	667	2278	280	165
-041A-6	R4	907	3098	280	165
-052A-6	R4	1117	3815	280	165
-062A-6	R4	1357	4634	280	165
-077A-6	R6	2310	7889	405	238
-099A-6	R6	2310	7889	405	238
-125A-6	R6	2310	7889	405	238
-144A-6	R6	2310	7889	405	238

3.4 Dimensions and Weights

3.4.1 Dimensions and Weights

The dimensions for the ACB530 depend on the frame size and enclosure type. If unsure of the frame size, first, find the "Type" designation on the drive labels (see sections Type designation on and Drive labels). Then locate that type designation in the rating tables (see Appendix A - Technical Specs), to determine the frame size.

Figure 3-1 Mounting Dimensions

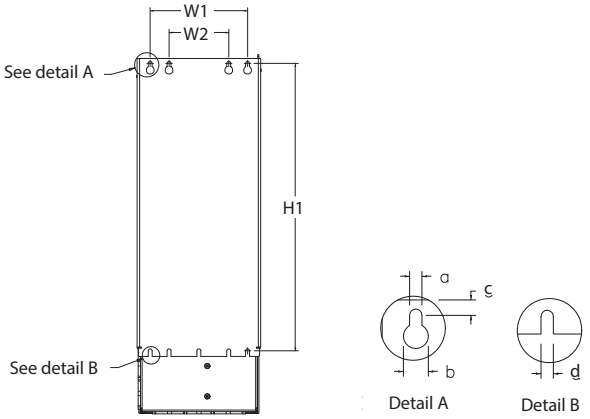
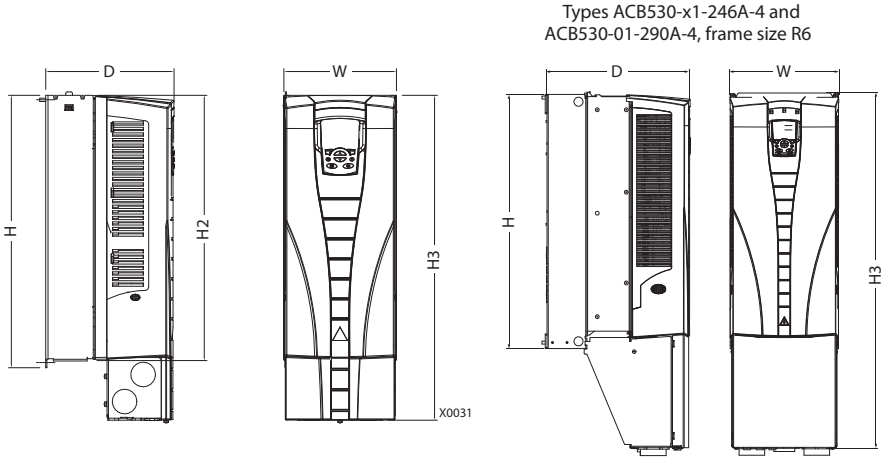


Table 3-6 IP21/UL type 1 and IP54 / UL type 12 - Dimensions for each Frame Size

Ref.	R1		R2		R3		R4		R5		R6	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
W1[1]	98.0	3.9	98.0	3.9	160	6.3	160	6.3	238	9.4	263	10.4
W2[1]	-	-	-	-	09.0	3.9	09.0	3.9	-	-	-	-
H1[1]	318	12.5	418	16.4	473	18.6	578	22.8	588	23.2	675	26.6
a	5.5	0.2	5.5	0.2	6.5	0.25	6.5	0.25	6.5	0.25	9.0	0.35
b	10.0	0.4	10.0	0.4	13.0	0.5	13.0	0.5	14.0	0.55	18.0	0.71
c	5.5	0.2	5.5	0.2	8.0	0.3	8.0	0.3	8.5	0.3	8.5	0.3
d	5.5	0.2	5.5	0.2	6.5	0.25	6.5	0.25	6.5	0.25	9.0	0.35

1. Center to center dimension.

Figure 3-2 Outside Dimensions - Drives with IP21 / UL type 1 Enclosures



IP21/UL type 1 - Dimensions for each Frame Size

Ref.	R1		R2		R3		R4		R5		R6	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
W	125	4.9	125	4.9	203	8.0	203	8.0	265	10.4	302	11.9
H	330	13.0	430	16.9	490	19.3	596	23.5	602	23.7	700	27.6
H2	315	12.4	415	16.3	478	18.8	583	23.0	578	22.8	698	27.5
H3	369	14.5	469	18.5	583	23.0	689	27.1	736	29.0	888[1]	35.0[1]
D	212	8.3	222	8.7	231	9.1	262	10.3	286	11.3	400	15.8

1. ACB530-x1-246A-4 and ACB530-01-290A-4: 979mm / 38.5 in.

Figure 3-3 Outside Dimensions - Drives with IP54 / UL type 12 Enclosures

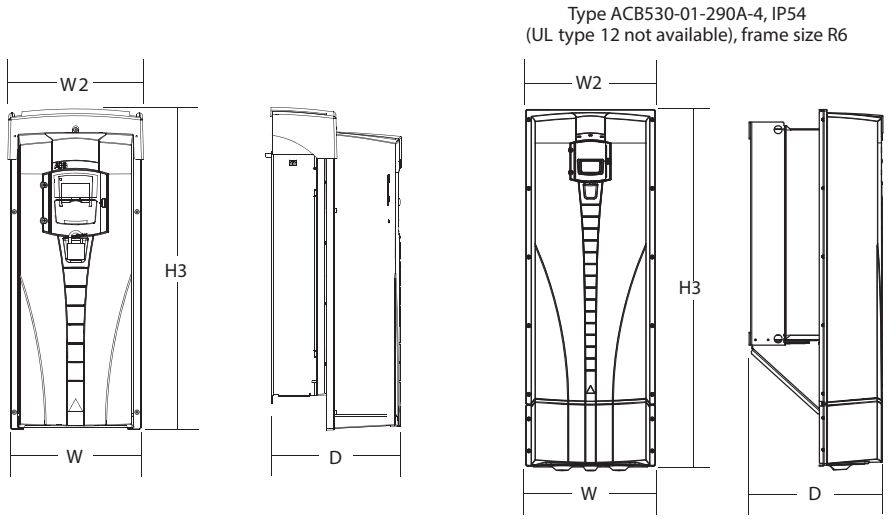


Table 3-7 IP54/UL type 12 - Dimensions for each Frame Size

Ref.	R1		R2		R3		R4		R5		R6	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
W	213	8.4	213	8.4	257	10.1	369	14.5	369	14.5	410	16.1
W2	222	8.8	222	8.8	267	10.5	369	14.5	369	14.5	410	16.1
H3	461	18.2	561	22.1	629	29.9	775	30.5	775	30.5	924[1]	36.4[1]
D	234	9.2	245	9.7	254	11.2	309	12.2	309	12.2	423	16.7

1. ACB530-01-290A-4: 1119mm / 44.1 in.
2. UL type 12 not available for ACB530-01-290A-4.

3.4.2 Weight

The following table lists typical maximum weights for each frame size. Variations within each frame size (due to components associated with ratings or options) are minor.

Table 3-8

Enclosure	R1		R2		R3		R4		R5		R6	
	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb
IP21/UL type 1	6.5	14.3	9.0	19.8	16.0	35.0	24.0	53.0	34.0	75.0	69.0[1]	152.0[1]
IP54/UL type 12	8.0	17.6	11.0	24.3	17.0	37.5	26.0	57.3	42.0	93.0	86.0[2]	190.0[2]

1. ACB530-x1-246A-4, IP21/UL type 1: 70 kg / 154 lb
   ACB530-01-290A-4, IP21/UL type 1: 80 kg / 176 lb
2. ACB530-x1-246A-4, IP54/UL type 12: 80 kg / 176 lb
   ACB530-01-290A-4, IP54: 90 kg / 198 lb (UL type 12 not available)

Table 3-9

Frame Size	Mounting Hardware	
R1 - R4	M5	#10
R5	M6	1/4 in
R6	M8	5/16 in

WARNING: Before installing the ACB530, ensure the input power supply to the drive is off.

For flange mounting (mounting the drive in a cooling air duct), see the appropriate Flange Mounting Instructions:

Table 3-10

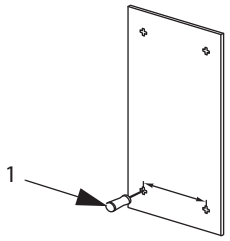
Frame size	IP21 / UL type 1		IP54 / UL type 12	
	Kit	Code (English)	Kit	Code (English)
R1	FMK-A-R1	100000982	FMK-B-R1	100000990
R2	FMK-A-R2	100000984	FMK-B-R2	100000992
R3	FMK-A-R3	100000986	FMK-B-R3	100000994
R4	FMK-A-R4	100000988	FMK-B-R4	100000996
R5	AC8-FLNGMT-R5 [1]	ACS800-PNTG01UEN	-	-
R6	AC8-FLNGMT-R6 [1]		-	-

1. Not available in ACB530-01 series.

3.5 Prepare to Mount the Drive

1. Mark the position of the mounting holes with the help of the mounting template provided with the drive.
2. Drill the holes.

Figure 3-4



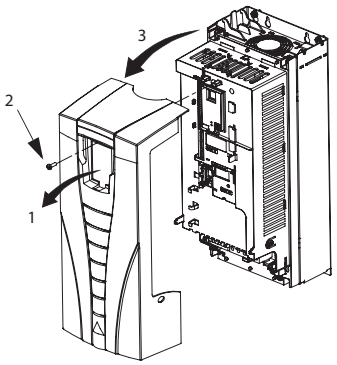
Note: Frame sizes R3 and R4 have four holes along the top. Use only two. If possible, use the two outside holes (to allow room to remove the fan for maintenance).

3.5.1 Remove the Front Cover

3.5.1.1 IP21 / UL type 1

1. Remove the control panel, if attached.
2. Loosen the captive screw at the top.
3. Pull near the top to remove the cover.

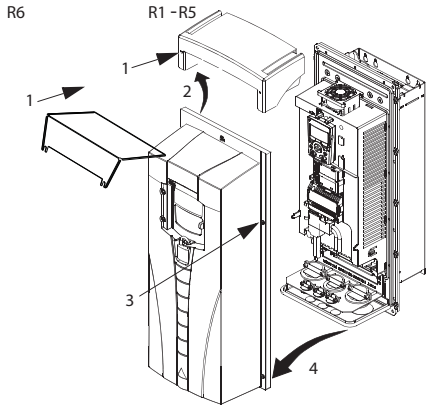
Figure 3-5



3.5.1.2 IP54 / UL type 12

1. If hood is present: Remove screws (2) holding hood in place.
2. If hood is present: Slide hood up and off of the cover.
3. Loosen the captive screws around the edge of the cover.
4. Remove the cover.

Figure 3-6



3.6 Mount the Drive

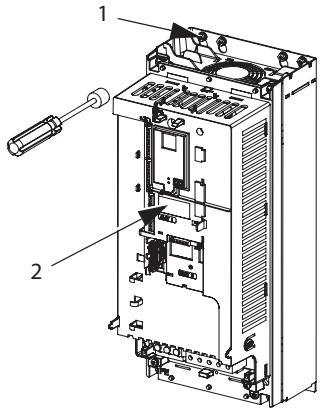
3.6.1 IP21 / UL type 1

1. Position the ACB530 onto the mounting screws or bolts and securely tighten in all four corners.

Note: Lift the ACB530 by its metal chassis (frame size R6 by the lifting holes on both sides at the top).

2. Non-English speaking locations: Add a warning sticker in the appropriate language over the existing warning on the top of the module.

Figure 3-7 IP21/UL type 1



3.6.2 IP54 / UL type 12

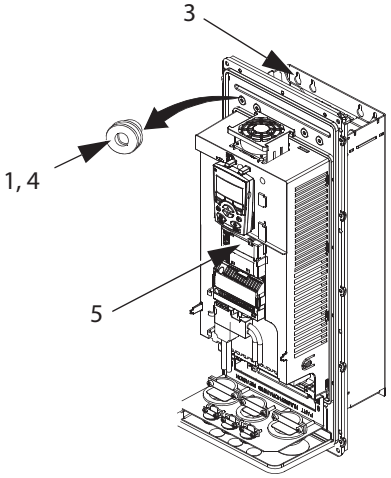
For the IP54 / UL type 12 enclosures, rubber plugs are required in the holes provided for access to the drive mounting slots.

1. As required for access, remove the rubber plugs. Push plugs out from the back of the drive.
2. R5 & R6: Align the sheet metal hood (not shown) in front of the drive's top mounting holes. (Attach as part of next step.)
3. Position the ACB530 onto the mounting screws or bolts and securely tighten in all four corners.

Note: Lift the ACB530 by its metal chassis (frame size R6 by the lifting holes on both sides at the top).

4. Reinstall the rubber plugs.
5. Non-English speaking locations: Add a warning sticker in the appropriate language over the existing warning on the top of the module.

Figure 3-8 IP54/UL type 12



Chapter 4
Power Wiring

4.1 Electrical installation

4.1.1 What this chapter contains

This chapter describes how to connect the power cables (incoming main power lines and motor power cabling) to the ACB530 Drive. It also addresses compatibility of the ACB530 with certain special power systems including IT (ungrounded) and corner-grounded TN Systems.

WARNING! The work described in this chapter may only be carried out by a qualified electrician. Follow the instructions in chapter 1 regarding safety.

- **Ignoring the safety instructions can cause injury or death.**
- **Make sure that the drive is disconnected from the input power during installation.**
- **If the drive is already connected to the input power, wait for 5 minutes after disconnecting the input power.**

4.2 Checking the insulation of the assembly

4.2.1 Drive

Do not make any voltage tolerance or insulation resistance tests (for example hi-pot or megger) on any part of the drive as testing can damage the drive. Every drive has been tested for insulation between the main circuit and the chassis at the factory.

Also, there are voltage-limiting circuits inside the drive which reduce the testing voltage automatically.

4.3 Planning the electrical installation

4.3.1 What this section contains

This section contains the instructions that you must follow when checking the compatibility of the motor and drive, and selecting cables, protections, cable routing and way of operation for the drive.

Note: The installation must always be designed and made according to applicable local laws and regulations. Baldor does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations. Furthermore, if the recommendations given by Baldor are not followed, the drive may experience problems that the warranty does not cover.

4.3.2 Implementing the AC power line connection

See the requirements in section Electric power supply specification. Use a fixed connection to the AC power line.

WARNING! As the leakage current of the device typically exceeds 3.5 mA, a fixed installation is required according to IEC 61800-5-1.

4.3.2.1 Using a line reactor

An line reactor should be used in cases where unstable supply networks exist. A line reactor can also be used to decrease the input fault current in case of an internal drive failure.

4.3.3 Disconnecting Device for Isolation

Install a hand-operated input disconnect (disconnecting means) between the AC power source and the drive. The disconnecting device must be of a type that can be locked to the open position for installation and maintenance work.

- **Europe:** To meet the European Union Directives, according to standard EN 60204-1, Safety of Machinery, the disconnecting device must be one of the following types:
  - a switch-disconnector of utilization category AC-23B (EN 60947-3) – a disconnector having an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector (EN 60947-3).
  - a circuit breaker suitable for isolation in accordance with EN 60947-2.
- **Other regions:** The disconnecting device must conform to regional applicable safety regulations.

Motor Compatibility

The motor, drive and supply power must be compatible:

Table 4-1

Motor Specification	Verify	Reference
Motor Type	3-phase induction motor	-
Nominal current	Motor current is within this range: 0.2…2.0 · I_{2hd} (I_{2hd} = drive heavy duty current)	Type designation label on drive, entry for Output I_{2hd}, or Type designation on drive and rating table in chapter Technical data on page 271.
Nominal frequency	10…500 Hz	
Voltage range	Motor is compatible with the ACB530 voltage range.	208…240 V (for ACB530-X1-XXXX-2) or 380…480 V (for ACB530-X1-XXXX-4) or 500…600 V (for ACB530-U1-XXXX-6)
Insulation	500…600 V drives: Either the motor complies with NEMA MG1 Part 31, or a dv/dt filter is used between the motor and drive.	For ACB530-U1-XXXX-6

4.4 Grounding the Drive

4.4.1 Ground Connections

For personnel safety, proper operation and reduction of electromagnetic emission/immunity, the drive and the motor must be grounded at the installation site.

- Conductors must be adequately sized as required by safety regulations.
- Power cable shields must be connected to the drive PE terminal in order to meet safety regulations.
- Power cable shields are suitable for use as equipment grounding conductors only when the shield conductors are adequately sized as required by safety regulations.
- In multiple drive installations, do not connect drive terminals in series.

4.4.2 Ground Fault Protection

ACB530 internal fault logic detects ground faults in the drive, motor, or motor cable.
This fault logic:
- is NOT a personal safety or fire protection feature
- can be disabled using parameter 3017 EARTH FAULT

Note: Disabling earth fault (ground fault) may void the warranty.
- could be tripped by leakage currents (input power to ground) associated with long high capacitance motor cables.

4.4.3 Grounding and Routing

4.4.3.1 Motor Cable Shielding

Motor cables require shielding using conduit, armored cable or shielded cable.
- Conduit – When using conduit:
  – Bridge joints with a ground conductor bonded to the conduit on each side of the joint.
  – Bond conduit run to the drive enclosure.
  – Use a separate conduit run for motor cables (also separate input power and control cables).
  – Use a separate conduit run for each drive.
- Armored cable – When using armored cable:
  – Use six-conductor (3 phases and 3 grounds), type MC continuous corrugated aluminium armor cable with symmetrical grounds.
  – Armored motor cable can share a cable tray with input power cables, but not with control cables.
- Shielded cable – For shielded cable details, see section Motor cable requirements for CE & C-Tick compliance.

4.4.3.2 Grounding

See section Ground Connections.

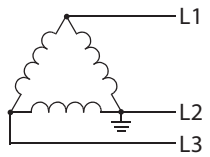
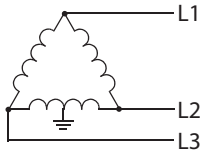
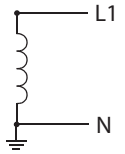
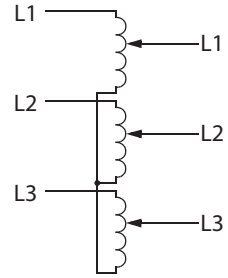
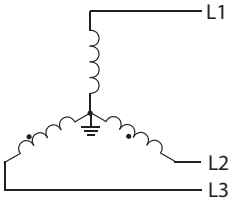
For CE compliant installations and installations where EMC emissions must be minimized, see section Effective motor cable shields.

4.4.3.3 Corner Grounded TN Systems

WARNING! Do not attempt to install or remove the EMC filter screws EM1, EM3, F1 or F2 while power is applied to the drive's input terminals.

Corner grounded TN systems are defined in the following table. In such systems, disconnect the internal ground connection through the EMC filter capacitors (do this also if the grounding configuration of the system is unknown), see section Disconnecting the internal EMC filter.

Table 4-1

<table>
<tr><th colspan="4">Corner grounded TN systems – EMC filter must be disconnected</th></tr>
<tr><td>Grounded at the corner of the delta</td><td> 
</td><td>Grounded at the mid point of a delta leg</td><td> 
</td></tr>
<tr><td>Single phase, grounded at an end point</td><td> 
</td><td>Three phase “Variac” without solidly grounded neutral</td><td> 
</td></tr>
<tr><td colspan="4">The EMC filter capacitors make an internal ground connection that reduces electro-magnetic emission. Where EMC (electro-magnetic compatibility) is a concern, and the system is symmetrically grounded, the EMC filter may be connected. For reference, the diagram on the right illustrates a symmetrically grounded TN system (TN-S system).
 
</td></tr>
</table>

4.4.3.4 IT Systems

WARNING! Do not attempt to install or remove the EMC filter screws EM1, EM3, F1 or F2 while power is applied to the drive's input terminals.

For IT systems (an ungrounded power system or a high-resistance-grounded [over 30ohm] power system):

- Disconnect the ground connection to the internal EMC filter, see section Disconnecting the internal EMC filter.
- Where EMC requirements exist, check for excessive emission propagated to neighboring low voltage networks. In some cases, the natural suppression in transformers and cables is sufficient. If in doubt, use a supply transformer with static screening between the primary and secondary windings.
- Do NOT install an external RFI/EMC filter. Using an EMC filter grounds the input power through the filter capacitors, which could be dangerous and could damage the drive.

4.5 Wiring Overview

4.5.1 Conduit/Gland Kit

Wiring drives with the IP21 / UL type 1 enclosure requires a conduit/gland kit with the following items:

- conduit/gland box
- screws
- cover.

The kit is included with IP21 / UL type 1 enclosures.

4.5.2 Wiring Requirements

WARNING! Ensure the motor is compatible for use with the ACB530. The drive must be installed by a competent person in accordance with the considerations defined in section Preparing for Installation. If in doubt, contact your local Baldor District Office.

As you install the wiring, observe the following:

- There are four sets of wiring instructions – one set for each combination of drive enclosure type (IP21 / UL type and IP54 / UL type 12) and wiring type (conduit or cable). Be sure to select the appropriate procedure.
- Determine electro-magnetic compliance (EMC) requirements per local codes. See section Motor cable requirements for CE & C-Tick compliance - Appendix C.

In general:
- Follow local codes for cable size.
- Keep these four classes of wiring separated: input power wiring, motor wiring, control/communications wiring and braking unit wiring.
- When installing input power and motor wiring, refer to the following, as appropriate:

Table 4-1

Terminal	Description
U1, V1, W1[1]	3-Phase Power Supply Input
PE	Protective Guard
U2, V2, W2	Power Output to Motor

[1] The ACB530-U1-xxxx-2 (208 - 240V series) can be used with a single phase supply, if output current is derated by 50%. For single phase supply voltage, connect power at U1 and W1.

- For frame size R6, see section Power Terminal Considerations – R6 frame size to install the appropriate cable lugs.
- For drives using braking (optional), refer to the following, as appropriate:

Table 4-2

Frame Size	Terminal	Description	Braking Accessory
R1, R2	BRK+, BRK-	Braking Resistor	Braking resistor. See section Brake Components.
R3, R4, R5, R6	UDC+, UDC-	DC Bus	Contact your local Baldor District Office to order either: • braking unit or • chopper and resistor

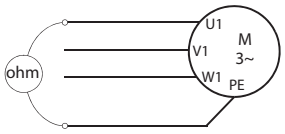
4.5.3 Install the Wiring

4.5.3.1 Checking Motor and Motor Cable Insulation

WARNING! Check the motor and motor cable insulation before connecting the drive to input power. For this test, make sure that motor cables are NOT connected to the drive.

1. Complete motor cable connections to the motor, but NOT to the drive output terminals (U2, V2, W2).
2. Measure the insulation resistance between each phase conductor and the Protective Earth conductor using a measuring voltage of 500VDC. The insulation resistance of an ABB motor must exceed 10Mohm (reference value at 25°C or 77°F). For the insulation resistance of other motors, please consult the manufacturer's instructions. Note: Moisture inside the motor casing will reduce the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.

Figure 4-1



4.5.4 Wiring IP21 / UL Type 1 Enclosure with Cables

1. Open the appropriate knockouts in the conduit/gland box. (See section Conduit/Gland kit.)
2. Install the cable clamps for the power/motor cables.
3. On the input power cable, strip the sheathing back far enough to route individual wires.
4. On the motor cable, strip the sheathing back far enough to expose the copper wire shield so that the shield can be twisted into a bundle (pig-tail). Keep the bundle not longer than five times its width to minimize noise radiation.

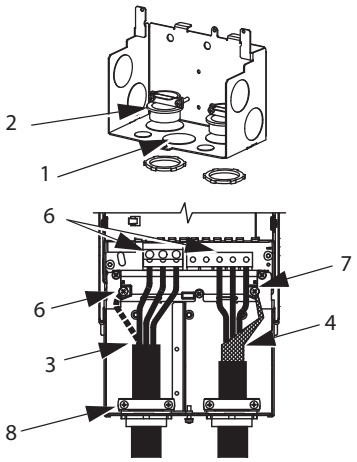
360° grounding under the clamp is recommended for the motor cable to minimize noise radiation. In this case, remove the sheathing at the cable clamp.

5. Route both cables through the clamps.
6. Strip and connect the power/motor wires and the power ground wire to the drive terminals. See the table on the right for tightening torques.

Note: For R6 frame size, refer to section Power terminal considerations – R6 frame size.

7. Connect the bundle (pig-tail) created from the motor cable shield to the GND terminal.

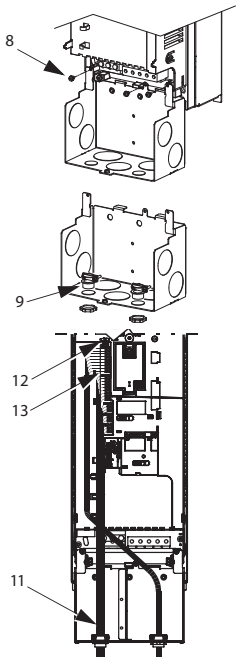
Figure 4-2



Frame Size	Tightening Torque	
	N-m	lb-ft
R1, R2	1.4	1
R3	2.5	1.8
R4	5.6; PE: 2	4; PE: 1.5
R5	15	11
R6	40; PE: 8	30; PE: 6

8. Install conduit/gland box and tighten the cable clamps.
9. Install the cable clamp(s) for the control cable(s). (Power/motor cables and clamps not shown in the figure.)
10. Strip control cable sheathing and twist the copper shield into a bundle (pig-tail).
11. Route control cable(s) through clamp(s) and tighten clamp(s).
12. Connect the ground shield bundle (pig-tail) for digital and analog I/O cables at X1-1. (Ground only at the drive end.)
13. Strip and connect the individual control wires to the drive terminals. See section Control terminals table. Use a tightening torque of 0.4 N·m (0.3 lb·ft).
14. Install the conduit/gland box cover (1 screw).

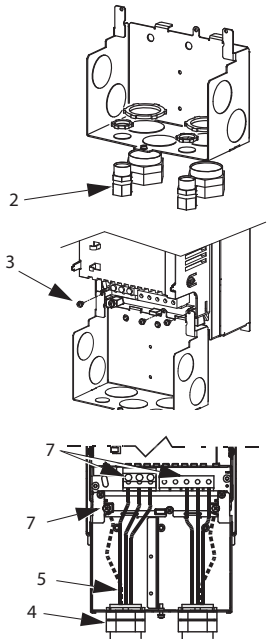
Figure 4-3



4.5.5 Wiring IP21 / UL Type 1 Enclosure with Conduit

1. Open the appropriate knockouts in the conduit/gland box. (See section Conduit/Gland kit.)
2. Install thin-wall conduit clamps (not supplied).
3. Install conduit/gland box.
4. Connect conduit runs to box.
5. Route input power and motor wiring through conduits (must be separate conduit runs).
6. Strip wires.
7. Connect power, motor and ground wires to the drive terminals. See the table on the right for tightening torques.

Figure 4-4

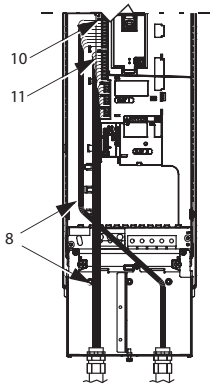


Frame Size	Tightening Torque	
	N-m	lb-ft
R1, R2	1.4	1
R3	2.5	1.8
R4	5.6; PE: 2	4; PE: 1.5
R5	15	11
R6	40; PE: 8	30; PE: 6

Note: For R6 frame size, refer to section Power Terminal Considerations – R6 frame size.

8. Route the control cable through the conduit (must be separate from input power and motor conduit runs).
9. Strip the control cable sheathing and twist the copper shield into a bundle (pig-tail).
10. Connect the ground shield bundle (pig-tail) for digital and analog I/O cables at X1-1. (Ground only at the drive end.)
11. Strip and connect the individual control wires to the drive terminals. See section Control terminals table. Use a tightening torque of 0.4N·m (0.3lb·ft).
12. Install the conduit/gland box cover (1screw).

Figure 4-5



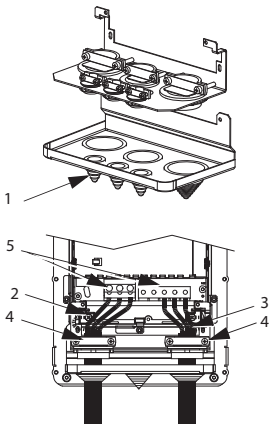
4.5.6 Wiring IP54 / UL Type 12 Enclosure with Cables

1. Cut the cable seals as needed for the power, motor and control cables. The cable seals are cone-shaped, rubber seals on the bottom of the drive. The conical part of the seals must face downwards when the seals are inserted in the lead-through plate holes.
2. On the input power cable, strip the sheathing back far enough to route individual wires.
3. On the motor cable, strip the sheathing back far enough to expose the copper wire shield so that the shield can be twisted into a bundle (pig-tail). Keep the bundle not longer than five times its width to minimize noise radiation.

   360° grounding under the clamp is recommended for the motor cable to minimize noise radiation. In this case, remove the sheathing at the cable clamp.

4. Route both cables through the clamps and tighten the clamps.
5. Strip and connect the power/motor wires and the power ground wire to the drive terminals. See the table below on the right for tightening torques.

Figure 4-6

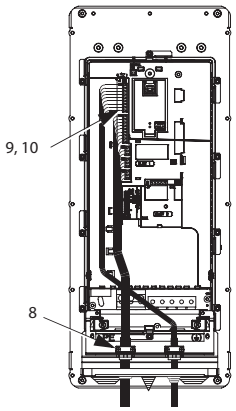


Frame Size	Tightening Torque	
	N-m	lb-ft
R1, R2	1.4	1
R3	2.5	1.8
R4	5.6; PE: 2	4; PE: 1.5
R5	15	11
R6	40; PE: 8	30; PE: 6

Note: For R6 frame size, refer to section Power terminal considerations – R6 frame size.

6. Connect the bundle (pig-tail) created from the motor cable shield to the GND terminal.
7. Strip control cable sheathing and twist the copper shield into a bundle (pig-tail).
8. Route control cable(s) through clamp(s) and tighten clamp(s).
9. Connect the ground shield bundle (pig-tail) for digital and analog I/O cables at X1-1. (Ground only at the drive end.)
10. Strip and connect the individual control wires to the drive terminals. See section Control terminals table. Use a tightening torque of 0.4N·m (0.3lb·ft).

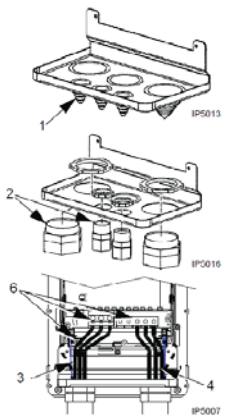
Figure 4-7



4.5.7 Wiring IP54 / UL Type 12 Enclosure with Conduit

1. Remove and discard the cable seals where conduit will be installed. (The cable seals are cone-shaped, rubber seals on the bottom of the drive.)
2. For each conduit run, install water tight conduit connectors (not supplied).
3. Route the power wiring through the conduit.
4. Route the motor wiring through the conduit.
5. Strip the wires.
6. Connect the power, motor and ground wires to the drive terminals. See the table on the right for tightening torques.

Figure 4-8



Frame Size	Tightening Torque	
	N-m	lb-ft
R1, R2	1.4	1
R3	2.5	1.8
R4	5.6; PE: 2	4; PE: 1.5
R5	15	11
R6	40; PE: 8	30; PE: 6

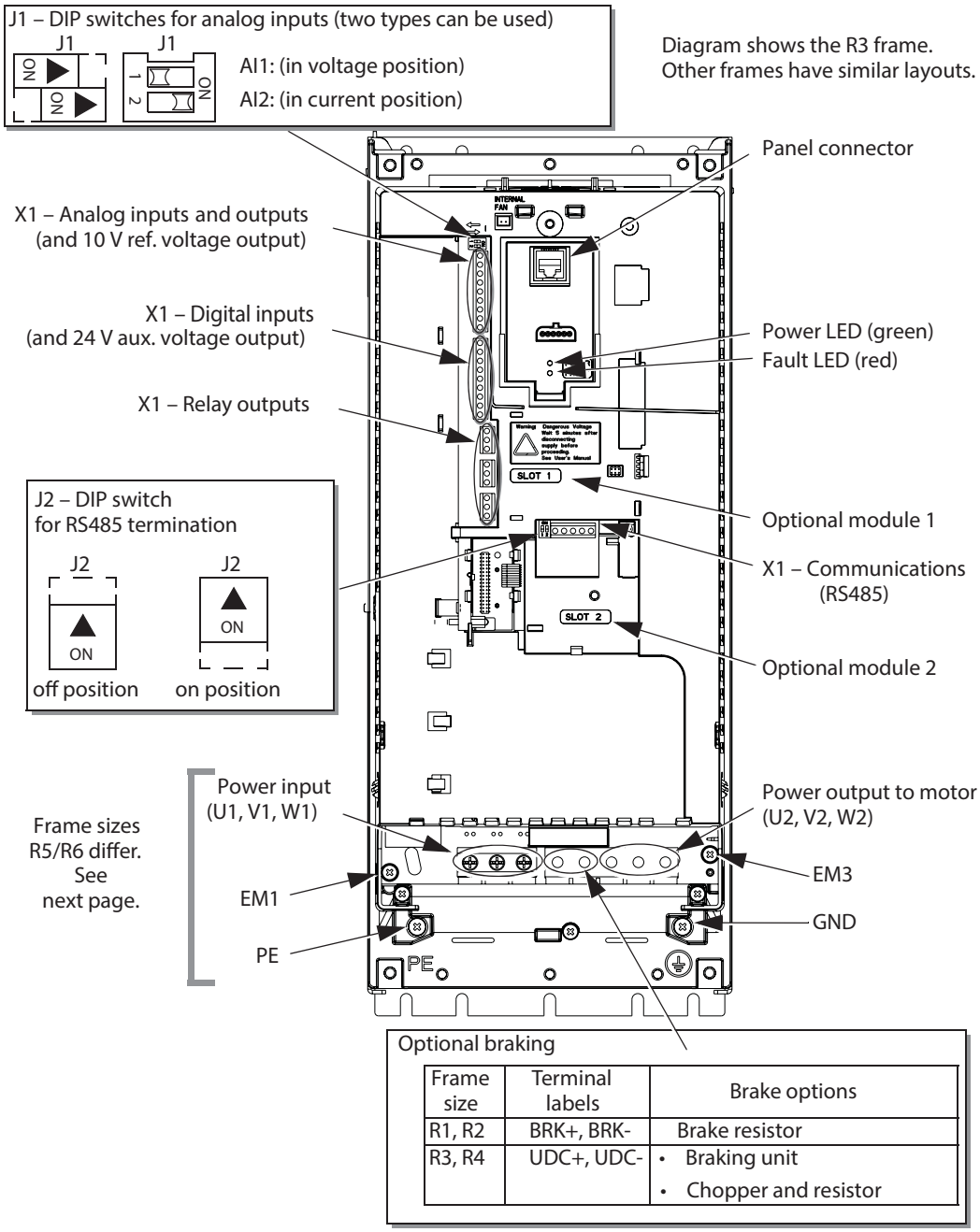
Note: For R6 frame size, refer to section Power terminal considerations – R6 frame size.

7. Route the control cable through the conduit.
8. Strip the control cable sheathing and twist the copper shield into a bundle (pig-tail).
9. Connect the ground shield bundle (pig-tail) for digital and analog I/O cables at X1-1. (Ground only at the drive end.)
10. Strip and connect the individual control wires to the drive terminals. See section Control terminals table. Use a tightening torque of 0.4N·m (0.3lb·ft).

4.5.8 Power Connection Diagrams

The following diagram shows the terminal layout for frame size R3, which, in general, applies to frame sizes R1 through R6, except for the R5/R6 power and ground terminals.

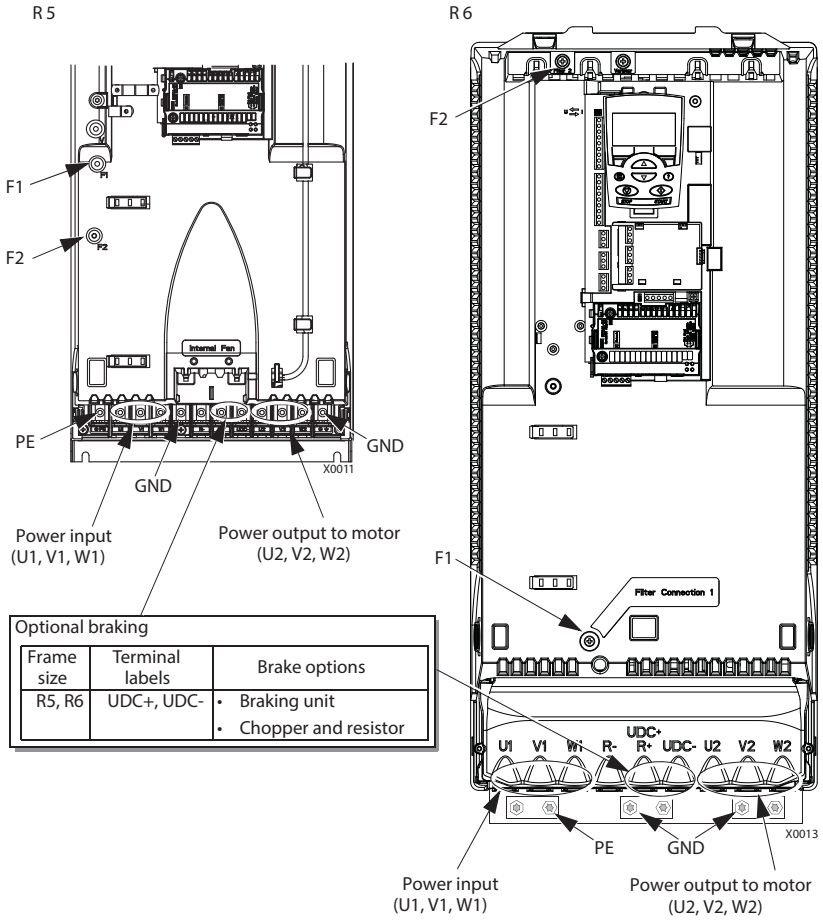
Figure 4-9 R3 Terminal Layout



WARNING! To avoid danger, or damage to the drive, on IT systems and corner grounded TN systems, see section Disconnecting the Internal EMC Filter.

The following diagram shows the power and ground terminal layout for frame sizes R5 and R6.

Figure 4-10 R5 and R6 Power and Ground Terminal Layout



WARNING! To avoid danger, or damage to the drive, on IT systems and corner grounded TN systems, see section Disconnecting the Internal EMC Filter.

4.5.9 Disconnecting the Internal EMC Filter

On certain types of systems, you must disconnect the internal EMC filter, otherwise the system will be connected to ground potential through the EMC filter capacitors, which might cause danger, or damage the drive.

Note: When the internal EMC filter is disconnected, the drive is not EMC compatible.

The following table shows the installation rules for the EMC filter screws in order to connect or disconnect the filter, depending on the system type and the frame size. For more information on the different system types, see IT Systems on and Corner Grounded TN Systems. The locations of screws EM1 and EM3 are shown in Figure 4-1.

The locations of screws F1 and F2 are shown in Figure 4-2.

Table 4-3

Frame sizes	Screw	Symmetrically grounded TN systems (TN-S systems)	Corner grounded TN systems	IT systems (ungrounded or high-resistance grounded [> 30 ohm])
R1 - R3	EM[1]	x	x	•
	EM3[1]	x	•	•
R4	EM[1]	x	x	–
	EM3[1]	x	–	–
R5 - R6	F1	x	x	–
	F2	x	x	–

x = Install the screw. (EMC filter will be connected.)

• = Replace the screw with the provided polyamide screw. (EMC filter will be disconnected.)

– = Remove the screw. (EMC filter will be disconnected.)

[1] = ACB530-U1 drives are shipped with screw EM3 already removed.

4.6 Drive's Power Connection Terminals

The following table provides specifications for the drive's power connection terminals.

Table 4-4

Frame Size	U1, V1, W1 U2, V2, W2 Brk±, UDC± Terminals						Earthing PE Terminal			
	Minimum Wire Size		Maximum Wire Size		Tightening Torque		Maximum Wire Size		Tightening Torque	
	mm²	AWG	mm²	AWG	N-m	lb-ft	mm²	AWG	N-m	lb-ft
R1[1]	0.75	18	10.0	8	1.4	1.0	10.0	8	1.4	1.0
R2[1]	0.75	18	10.0	8	1,4	1.0	10.0	8	1.4	1.0
R3[1]	2.5	14	25.0	3	2.5	1.8	16.0	6	1.8	1.3
R4[1]	6.0	10	50.0	1/0	5.6	4.0	25.0	3	2.0	1.5
R5[1]	6.0	10	70.0	2/0	15.0	11.0	70.0	2/0	15.0	11.0
R6[2]	95.0[3]	3/0[3]	240.0	350 MCM	40.0	30.0	95.0	3/0	8.0	6.0

[1] Aluminum cable cannot be used with frame sizes R1 - R5 because of its lower capacity.

[2] Aluminum cable cannot be used with type ACB530-U1-290A-4 because of the terminal size.

[3] See section Power Terminal Considerations - R6 Frame Size.

Note: See the recommended cable sizes for different load currents in section Input Power Cables/Wiring.

4.6.1 Power Terminal Considerations - R6 Frame Size

WARNING! For R6 power terminals, if screw-on terminal lugs are supplied, they can only be used for wire sizes that are 95mm2 (3/0AWG) or larger. Smaller wires will loosen and may damage the drive. They require crimp-on ring lugs as described below.

4.6.2 Crimp-On Ring Lugs

On the R6 frame size, if screw-on terminal lugs are supplied but the cable size used is less than 95 mm² (3/0 AWG), or if no screw-on terminal lugs are supplied at all, use crimp-on ring lugs according to the following procedure.

1. Select appropriate ring lugs from the following table.
2. Remove the screw-on terminal lugs, if supplied.
3. Attach the ring lugs to the drive end of the cables.
4. Isolate the ends of the ring lugs with insulating tape or shrink tubing.
5. Attach the ring lugs to the drive.

Figure 4-11 Crimp-On Ring Lugs

Table 4-5

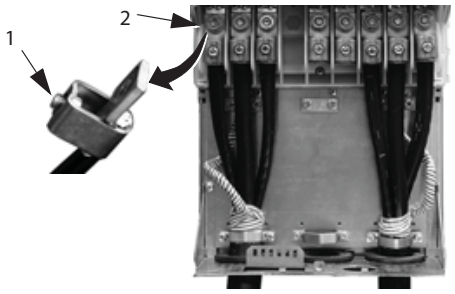
Wire Size		Manufacturer	Ring Lug	Crimping Tool	No. of Crimps
mm^2	kcmil/ AWG				
16	6	Burndy	YAV6C-L2	MY29-3	1
		Ilsco	CCL-6-38	ILC-10	2
25	4	Burndy	YA4C-L4BOX	MY29-3	1
		Ilsco	CCL-4-38	MT-25	1
35	2	Burndy	YA2C-L4BOX	MY29-3	2
		Ilsco	CRC-2	IDT-12	1
		Ilsco	CCL-2-38	MT-25	1
50	1	Burndy	YA1C-L4BOX	MY29-3	2
		Ilsco	CRA-1-38	IDT-12	1
		Ilsco	CCL-1-38	MT-25	1
		Thomas & Betts	54148	TBM-8	3
55	1/0	Burndy	YA25-L4BOX	MY29-3	2
		Ilsco	CRB-0	IDT-12	1
		Ilsco	CCL-1/0-38	MT-25	1
		Thomas & Betts	54109	TBM-8	3
70	2/0	Burndy	YAL26T38	MY29-3	2
		Ilsco	CRA-2/0	IDT-12	1
		Ilsco	CCL-2/0-38	MT-25	1
		Thomas & Betts	54110	TBM-8	3
95	3/0	Burndy	YAL27T38	MY29-3	2
		Ilsco	CRA-3/0	IDT-12	1
		Ilsco	CCL-3/0-38	MT-25	1
		Thomas & Betts	54111	TBM-8	3
95	3/0	Burndy	YA28R4	MY29-3	2
		Ilsco	CRA-4/0	IDT-12	1
		Ilsco	CCL-4/0-38	MT-25	2
		Thomas & Betts	54112	TBM-8	4

4.6.3 Screw-On Terminal Lugs

Use the following procedure to attach cables if screw-on terminal lugs are supplied and the cable size is 95 mm^2 (3/0 AWG) or larger.

1. Attach the supplied screw-on lugs to the drive end of the cables.
2. Attach screw-on lugs to the drive.

Figure 4-12 Screw-On Terminal Lugs



4.7 Input Power Connections

WARNING! Do not operate the drive outside the nominal input line voltage range. Overvoltage can result in permanent damage to the drive.

4.7.1 Input Power Specifications

Table 4-6 Input Power (Mains) Connection Specifications

Voltage (U1)	208/220/230/240 VAC 3-phase (or 1-phase) -15% to +10% for ACB530-x1-xxxx-2. 380/400/415/440/460/480 VAC 3-phase -15% to +10% for ACB530-x1- xxxx-4. 500/525/575/600 VAC 3-phase -15% to +10% for ACB530-U1-xxxx-6.
Prospective short-circuit current (IEC 629)	Maximum allowed prospective short-circuit current in the supply is 100kA providing that the input power cable of the drive is protected with appropriate fuses. US: 100 000 AIC.
Frequency	48 - 63 Hz
Imbalance	Max. ± 3% of nominal phase to phase input voltage
Fundamental power factor (cos phi$_1$)	0.98 (at nominal load)
Cable temperature rating	90°C (194°F) rating minimum

4.7.2 Input Power Cables/Wiring

Input wiring can be any of:
- a four conductor cable (three phases and ground/protective earth). Shielding is not required.
- four insulated conductors routed through conduit.

Size wiring according to local safety regulations, appropriate input voltage and the drive's load current. In any case, the conductor must be less than the maximum limit defined by the terminal size (see section Drive's Power Connection Terminals).

The table below lists copper and aluminium cable types for different load currents.
These recommendations apply only for the conditions listed at the top of the table.

Table 4-7 Copper and Aluminum Cable Types for Different Load Currents

IEC				**NEC**	
Based on: • EN 60204-1 and IEC 60364-5-2/2001 • PVC insulation • 30°C (86°F) ambient temperature • 70°C (158°F) surface temperature • cables with concentric copper shield • not more than nine cables laid on cable ladder side by side				Based on: • NEC Table 310-16 for copper wires • 90°C (194°F) wire insulation • 40°C (104°F) ambient temperature • not more than three current-carrying conductors in raceway or cable, or earth (directly buried) • EN 602	
Max. Load Current A	**Cu Cable mm²**	**Max. Load Current A**	**Al Cable mm²**	**Max. Load Current A**	**Cu Wire Size AWG/kcmil**
14	3x1.5	Aluminum cable cannot be used with frame sizes R1 - R5 because of its lower capacity.		22.8	14
20	3x2.5			27.3	12
27	3x4			36.4	10
34	3x6			50.1	8
47	3x10			68.3	6
62	3x16			86.5	4
79	3x25			100	3
98	3x35	91	3x50	118	2
119	3x50	117	3x70	137	1
153	3x70	143	3x95	155	1/0
186	3x95	165	3x120	178	2/0
215	3x120	191	3x150	205	3/0
249	3x150	218	3x185	237	4/0
284	3x185	257	3x240	264	250 MCM or 2x1
330	3x240	274	3x(3x50)	291	300 MCM or 2x1/0
		285	2x(3x95)	319	350 MCM or 2x2/0

4.8 Brake Components

4.8.1 Compatibility

Braking availability for ACB530 drives, varies by frame size as shown below:

- R1 and R2 – a built-in brake chopper is standard equipment. Add appropriate resistor, as determined using the following section. Resistors are available from Baldor.
- R3 through R6 – does not include an internal brake chopper. Connect a chopper and a resistor, or a brake unit to the DC link terminals on the drive. Contact your Baldor District Office for appropriate parts.

4.8.2 Selecting the Braking Resistors (Frame Sizes R1 and R2)

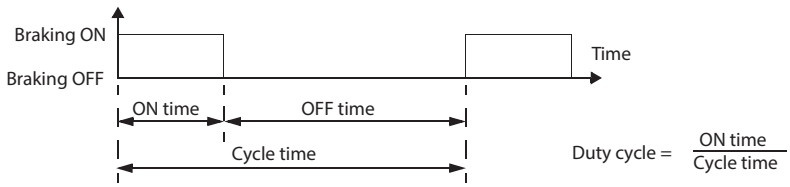
Braking resistor must meet three requirements:

- Resistance must be always higher than the minimum value RMIN defined for the drive type in the following tables. Never use resistance below this value.
- Resistance must be low enough to be able to produce the desired braking torque. To achieve the maximum braking torque (the larger of 150% of heavy duty or 110% of nominal duty), the resistance must not exceed RMAX. If maximum braking torque is not necessary, resistor values can exceed RMAX.
- The resistor power rating must be high enough to dissipate the braking power.

This requirement involves many factors:

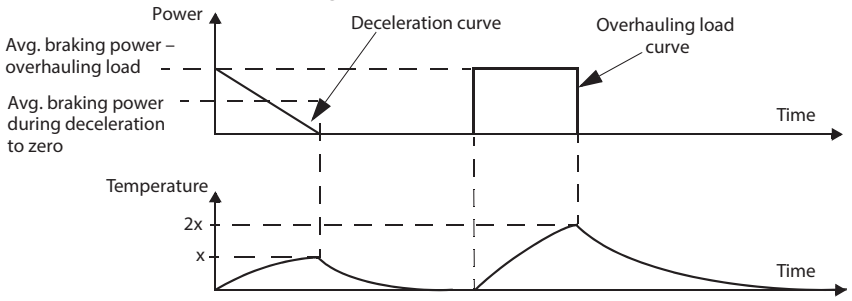
- the maximum continuous power rating for the resistor(s)
- the rate at which the resistor changes temperature (resistor thermal time constant)
- maximum braking time ON – If the regeneration (braking) power is larger than the resistor rated power, there is a limit to the ON time, or the resistor overheats before the OFF period begins.
- minimum braking time OFF – If the regeneration (braking) power is larger than the resistor rated power, the OFF time must be large enough for the resistor to cool between ON periods.

Figure 4-13



- the peak braking power requirement
- type of braking (deceleration to zero vs. overhauling load) – During deceleration to zero, the generated power steadily
- for example) and the braking power is constant. The total heat generated from an overhauling load is double the heat generated from deceleration to zero speed (for the same peak torque and ON time).

Figure 4-14



The many variables in the last requirement above are most easily dealt with using the following tables.

- First, determine your maximum braking time ON (ON_{MAX}), minimum braking time OFF (OFF_{MIN}) and load type (deceleration or overhauling load).
- Calculate duty cycle:

$$\text{Duty cycle} = \frac{ON_{MAX}}{(ON_{MAX} + OFF_{MIN})} \cdot 100\%$$

- In the appropriate table, find the column that best matches your data:
  - ONMAX ≤ column specification and
  - Duty cycle ≤ column specification
- Find the row that matches your drive.
- The minimum power rating for deceleration to zero is the value in the selected row/column.
- For overhauling loads, double the rating in the selected row/column, or use the “Continuous ON” column.

Table 4-8 208 - 240V Drives

Type ACB530-U1- see below	Resistance		Resistor[1] Minimum Continuous Power Rating				
			Deceleration-to-Zero Rating				***P*rcont** Continuous ON > 60 s ON > 25% Duty
	R_{MAX}	R_{MIN}	***P*r3** ≤ 3 s ON ≥ 27 s OFF ≤ 10% Duty	***P*r10** ≤ 10 s ON ≥ 50 s OFF ≤ 17% Duty	***P*r30** ≤ 30 s ON ≥ 180 s OFF ≤ 14% Duty	***P*r60** ≤ 60 s ON ≥ 180 s OFF ≤ 25% Duty	
	ohm	**ohm**	**W**	**W**	**W**	**W**	**W**
Three-phase supply voltage, **208 - 240V**							
-04A6-2	234	80	45	80	120	200	1100
-06A6-2	160	80	65	120	175	280	1500
-07A5-2	117	44	85	160	235	390	2200
-012A-2	80	44	125	235	345	570	3000
-017A-2	48	44	210	390	575	950	4000
-024A-2	32	30	315	590	860	1425	5500
-031A-2	23	22	430	800	1175	1940	7500

[1] Resistor time constant specification must be ≥ 85 seconds.

Table 4-9 380 - 480V Drives

Type ACB530-U1- see below	Resistance		Resistor[1] Minimum Continuous Power Rating				
			Deceleration-to-Zero Rating				***P*rcont** Continuous ON > 60 s ON > 25% Duty
	R_{MAX}	R_{MIN}	***P*r3** ≤ 3 s ON ≥ 27 s OFF ≤ 10% Duty	***P*r10** ≤ 10 s ON ≥ 50 s OFF ≤ 17% Duty	***P*r30** ≤ 30 s ON ≥ 180 s OFF ≤ 14% Duty	***P*r60** ≤ 60 s ON ≥ 180 s OFF ≤ 25% Duty	
	ohm	**ohm**	**W**	**W**	**W**	**W**	**W**
Three-phase supply voltage, **380 - 480V**							
-03A3-4	641	120	65	120	175	285	1100
-04A1-4	470	120	90	160	235	390	1500
-05A4-4	320	120	125	235	345	570	2200
-06A9-4	235	80	170	320	470	775	3000
-08A8-4	192	80	210	400	575	950	4000
-012A-4	128	80	315	590	860	1425	5500
-015A-4	94	63	425	800	1175	1950	7500
-023A-4	64	63	625	1175	1725	2850	11000

[1] Resistor time constant specification must be ≥ 85 seconds.

Table 4-10 500 - 600V Drives

Type ACB530-U1- see below	Resistance		Resistor[1] Minimum Continuous Power Rating				
			Deceleration-to-Zero Rating				***P*rcont** Continuous ON > 60 s ON > 25% Duty
	R_{MAX}	R_{MIN}	***P*r3** ≤ 3 s ON ≥ 27 s OFF ≤ 10% Duty	***P*r10** ≤ 10 s ON ≥ 50 s OFF ≤ 17% Duty	***P*r30** ≤ 30 s ON ≥ 180 s OFF ≤ 14% Duty	***P*r60** ≤ 60 s ON ≥ 180 s OFF ≤ 25% Duty	
	ohm	**ohm**	**W**	**W**	**W**	**W**	**W**
Three-phase supply voltage, **500 - 600V**							
-02A7-6	548	80	93	175	257	425	1462
-03A6-6	373	80	137	257	377	624	2144
-06A1-6	224	80	228	429	639	1040	3573
-06A0-6	149	80	342	643	943	1560	5359
-011A-6	110	60	467	877	1286	2127	7308
-017A-6	75	60	685	1286	1886	3119	10718

[1] Resistor time constant specification must be ≥ 85 seconds.

WARNING! Never use a brake resistor with a resistance below the minimum value specified for the particular drive. The drive and the internal chopper are not able to handle the overcurrent caused by the low resistance.

4.8.3 Symbols

$\mathbf{R_{MIN}}$ – Minimum allowed resistance of the braking resistor.

$\mathbf{R_{MAX}}$ – Maximum resistance to provide maximum breaking torque.

$\mathbf{P_{rx}}$ – Duty-cycle based resistor power rating (watts), where "x" is ON time.

4.8.4 Installing and Wiring Resistors

All resistors must be installed outside the drive module in a place where they can dissipate heat.

WARNING! The surface temperature of the resistor is very high, and air flowing from the resistor is very hot. Materials near the brake resistor must be non-flammable. Provide protection from accidental contact with the resistor.

To ensure that the input fuses protect the resistor cable, use resistor cables with the same rating as used for the power input to the drive.

The maximum length of the resistor cable(s) is 10 m (33 ft). See section Power Connection diagrams for the resistor cable connection points.

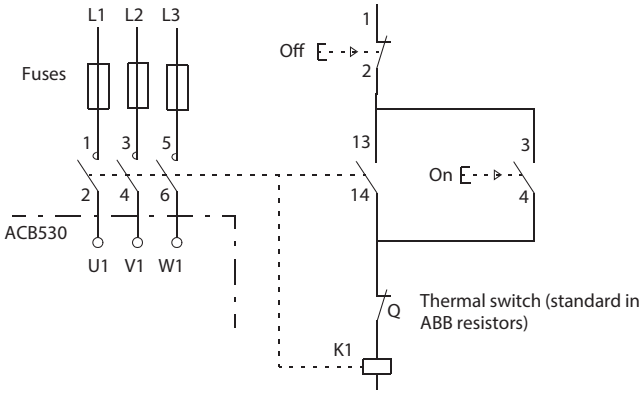
4.8.5 Mandatory Circuit Protection

The following setup is required for safety – it interrupts the main supply in fault situations involving dynamic breaking chopper shorts:

- Equip the drive with a main contactor.
- Wire the contactor so that it opens if the resistor thermal switch opens (an overheated resistor opens the contactor).

Below is a simple wiring diagram example.

Figure 4-15



4.8.6 Parameter Set-Up

To enable dynamic braking, switch off the drive's overvoltage control [Set parameter 2005 = 0 (DISABLE)].

4.9 Motor Connections

WARNING! Never connect line power to the drive output terminals: U2, V2 or W2. Line voltage applied to the output can result in permanent damage to the drive. If frequent bypassing is required, use mechanically interlocked switches or contactors.

WARNING! Do not connect any motor with a nominal voltage less than one half of the drive's nominal input voltage.

WARNING! Disconnect the drive before conducting any voltage tolerance (Hi-Pot) test or insulation resistance (Megger) test on the motor or motor cables. Do not conduct these tests on the drive.

4.9.1 Motor Connection Specifications

Table 4-1 Motor Connection Specifications

Voltage (U_2)	0 - U_1, 3-phase symmetrical, U_{max} at the field weakening point
Frequency	0 - 500 Hz
Frequency Resolution	0.01 Hz
Current	See section Ratings
Field Weakening Point	10 - 500 Hz
Switching Frequency	Selectable. See the availability in the table below.

	1, 2, 4 and 8 kHz	12 kHz
208 - 240V	All types	Frame sizes R1 - R4 in scalar control mode
380 - 480V	All types	Frame sizes R1 - R4 (except ACB530-01-097A-4) in scalar control mode
500 - 600V	All types	Frame sizes R2 - R4 in scalar control mode

Cable Temperature Rating	90°C (194°F) rating minimum.
Maximum Motor Cable Length	See section Motor Cable Lengths.

4.9.2 Motor Cable Lengths

Maximum motor cable lengths for 460V and 600V drives are given in the sections below.

In multimotor systems, the calculated sum of all motor cable lengths must not exceed the maximum motor cable length given in the appropriate table below.

4.9.2.1 Motor Cable Length for 460V Drives

The table below shows the maximum motor cable lengths for 460V drives with different switching frequencies. Examples for using the table are also given.

Table 4-2 Maximum Cable Length for 460V Drives

Frame Size	EMC Limits												Operational Limits					
	Second Environment (Category C3[1])						First Environment (Category C2[1])						Basic Unit				With du/dt filters	
	1 kHz		4 kHz		8 kHz		1 kHz		4 kHz		8 kHz		1/4 kHz		8/12 kHz			
	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft
R1	300	980	300	980	300	980	300	980	300	980	300	980	100	330	100	330	150	490
R2	300	980	300	980	300	980	300	980	100	330	30	98	200	660	100	330	250	820
R3	300	980	300	980	300	980	300	980	75	245	75	245	200	660	100	330	250	820
R4	300	980	300	980	300	980	300	980	75	245	75	245	200	660	100	330	300	980
R5	100	330	100	330	100	330	100	330	100	330	100	330	300	980	150[2]	490[2]	300	980
R6	100	330	100	330	[3]	[3]	100	330	100	330	[3]	[3]	300	980	150[2]	490[2]	300	980

[1] See the new terms in section IEC/EN 61800-3 (2004) Definitions.

[2] 12 kHz switching frequency is not available.

[3] Not tested.

Sine filters further extend the cable lengths.

Under heading “Operational limits”, the “Basic unit” columns define the cable lengths with which the basic drive unit works without problems within the drive specification, without installing any further options. Column “With du/dt filters” defines the cable lengths when an external du/dt filter is used.

The columns under heading “EMC limits” show the maximum cable lengths with which the units have been tested for EMC emissions. The factory guarantees that these cable lengths meet the EMC standard requirements.

If external sine filters are installed, longer cable lengths can be used. With sine filters the limiting factors are the voltage drop of the cable, which has to be taken into account in engineering, as well as the EMC limits (where applicable).

The default switching frequency is 4 kHz.

WARNING! Using a motor cable longer than specified in the table above may cause permanent damage to the drive.

Examples for using the table:

Requirements	Checking and Conclusions
R1 frame size, 8 kHz fsw, Category C2, 150 m (490 ft) cable	Check operational limits for R1 and 8 kHz -> for a 150 m (490 ft) cable a du/dt filter is needed. Check EMC limits -> EMC requirements for Category C2 are met with a 150 m (490 ft) cable.
R3 frame size, 4 kHz fsw, Category C3, 150 m (490 ft) cable	Check operational limits for R3 and 4 kHz -> a 300 m (980 ft) cable cannot be used even with a du/dt filter. A sine filter must be used and the voltage drop of the cable must be taken into account in the installation. Check EMC limits -> EMC requirements for Category C3 are ment with a 300 m (980 ft) cable.
R5 frame size, 8 kHz fsw, Category C3, 150 m (490 ft) cable	Check operational limits for R5 and 8 kHz -> for a 150 m (490 ft) cable the basic unit is sufficient. Check EMC limits -> EMC requirements for Category C3 cannot be met with a 300 m (980 ft) cable. The installation configuration is not possible. An EMC plan is recommended to overcome the situation.
R6 frame size, 4 kHz fsw, EMC limits not applicable, 150 m (490 ft) cable	Check operational limits for R6 and 4 kHz -> for a 150 m (490 ft) cable the basic unit is sufficient. EMC limits do not need to be checked as there are no EMC requirements.

4.9.2.2 Motor Cable Length for 600V Drives

The table below shows the maximum motor cable lengths for 600 V drives with different switching frequencies. As the 600V drives are not CE approved, cable lengths for EMC limits are not given.

Table 4-3 Maximum Cable Length for 600V Drives

Frame Size	Operational Limits			
	Basic Unit			
	1/4 kHz		8/12 kHz	
	m	ft	m	ft
R2	100	330	100	330
R3 - R4	200	660	100	330
R6	300	980	150[2]	490[2]

[2] 12 kHz switching frequency is not available.

WARNING! Using a motor cable longer than specified in the table above may cause permanent damage to the drive.

4.9.3 Motor Thermal Protection

According to regulations, the motor must be protected against thermal overload and the current must be switched off when overload is detected. The drive includes a motor thermal protection function that protects the motor and switches off the current when necessary. Depending on a drive parameter value (see parameter 3501 SENSOR TYPE), the function either monitors a calculated temperature value (based on a motor thermal model, see parameters 3005 MOT THERM PROT through 3009 BREAK POINT FREQ) or an actual temperature indication given by motor temperature sensors (see Group: MOTOR TEMP MEAS). The user can tune the thermal model further by feeding in additional motor and load data.

4.9.4 Emergency Stop Devices

The overall design of the installation must include emergency stop devices and any other safety equipment that may be needed. Pressing STOP on the drive's control panel does NOT:

- generate an emergency stop of the motor
- separate the drive from dangerous incoming voltage

4.10 Fuses

Branch circuit protection must be provided by the end user and sized per national and local electric codes. The following tables provide fuse recommendations for short circuit protection on the drive's input power.

The rated fuse currents given in the tables are the maximums for the mentioned fuse types. If smaller fuse ratings are used, check that the fuse rms current rating is larger than the input current.

Check that the operating time of the fuse is below 0.5 seconds. The operating time depends on the fuse type, the supply network impedance as well as the crosssectional area, material and length of the supply cable. In case the 0.5 seconds operating time is exceeded with the gG or T fuses, ultra rapid (aR) fuses will in most cases reduce the operating time to an acceptable level.

Table 4-4 Fuses, 208 - 240V Drives

ACB530-U1- see below	Input Current A	Input Power (mains) Fuses		
		IEC 60269 gG (A)	UL Class T (A)	Bussmann Type
-04A6-2	4.6	10	10	JJS-10
-06A6-2	6.6			
-07A5-2	7.5			
-012A-2	11.8	16	15	JJS-15
-017A-2	16.7	25	25	JJS-25
-024A-2	24.2		30	JJS-30
-031A-2	30.8	40	40	JJS-40
-046A-2	46.2	63	60	JJS-60
-059A-2	59.4		80	JJS-80
-075A-2	74.8	80	100	JJS-100
-088A-2	88.0	100	110	JJS-110
-114A-2	114	125	150	JJS-150
-143A-2	143	200	200	JJS-200
-178A-2	178	250	250	JJS-250
-221A-2	221	315	300	JJS-300
-248A-2	248		350	JJS-350

Table 4-5 Fuses, 380 - 480V Drives

ACB530-U1- see below	Input Current A	Input Power (mains) Fuses		
		IEC 60269 gG (A)	UL Class T (A)	Bussmann Type
-03A3-4	3.3	10	10	JJS-10
-04A1-4	4.1			
-05A4-4	5.4			
-06A9-4	6.9			
-08A8-4	8.8		15	JJS-15
-012A-4	11.9	16		
-015A-4	15.4		20	JJS-20
-023A-4	23	25	30	JJS-30
-031A-4	31	35	40	JJS-40
-038A-4	38	50	50	JJS-50
-045A-4	45		60	JJS-60
-059A-4	59	63	80	JJS-80
-072A-4	72	80	90	JJS-90
-078A-4	77		100	JJS-100
-087A-4	87	125	125	JJS-125
-097A-4	97			
-125A-4	125	160	175	JJS-175
-157A-4	157	200	200	JJS-200
-180A-4	180	250	250	JJS-250
-195A-4	205			
-246A-4	246	315	350	JJS-350
-290A-4	290			

Table 4-6 Fuses, 500 - 600V Drives

ACB530-U1- see below	Input Current A	Input Power (mains) Fuses		
		IEC 60269 gG (A)	UL Class T (A)	Bussmann Type
-02A7-6	2.7	10	10	JJS-10
-03A9-6	3.9			
-06A1-6	6.1			
-09A0-6	9.0	16	15	JJS-15
-011A-6	11			
-017A-6	17	25	25	JJS-25
-022A-6	22			
-027A-6	27	35	40	JJS-40
-032A-6	32			
-041A-6	41	50	50	JJS-50
-052A-6	52	60	60	JJS-60
-062A-6	62	80	80	JJS-80
-077A-6	77		100	JJS-100
-099A-6	99	125	150	JJS-150
-125A-6	125	160	175	JJS-175
-144A-6	144	200	200	JJS-200

4.11 Check Installation

Before applying power, perform the following checks.

√	Check
	Installation environment conforms to the drive's specifications for ambient conditions.
	The drive is mounted securely.
	Space around the drive meets the drive's specifications for cooling.
	The motor and driven equipment are ready for start.
	For IT systems and corner grounded TN systems: The internal EMC filter is disconnected (see section Disconnecting the internal EMC filter).
	The drive is properly grounded.
	The input power (mains) voltage matches the drive nominal input voltage.
	The input power (mains) connections at U1, V1 and W1 are connected and tightened as specified.
	The input power (mains) fuses are installed.
	The motor connections at U2, V2 and W2 are connected and tightened as specified.
	The motor cable is routed away from other cables.
	NO power factor compensation capacitors are in the motor cable.
	The control connections are connected and tightened as specified.
	NO tools or foreign objects (such as drill shavings) are inside the drive.
	NO alternate power source for the motor (such as a bypass connection) is connected – no voltage is applied to the output of the drive.

Chapter 5
Control Wiring

5.1 Control Connection Specifications

5.1.1 What this chapter contains

This chapter describes how to connect control signals (such as run and stop commands, analog references, digital outputs, etc.) to the ACB530. Typically these signals would connect the ACB530 to supervisory control equipment (such as a PLC) or to hand operators (such as push buttons, selector switches and indicator lights).

Table 5-1 Control Connection Specification

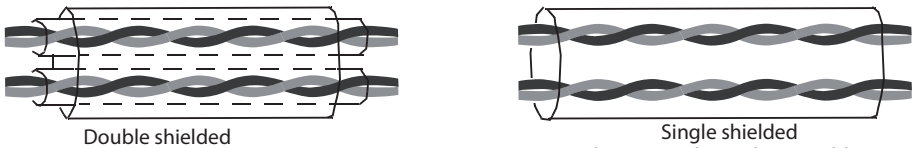
Analog Inputs and Outputs	See section Control Terminals table.
Digital Inputs	Digital input impedance 1.5 kohm. Maximum voltage for digital inputs is 30V.
Relays (Digital Outputs)	• Max. contact voltage: 30VDC, 250VAC • Max. contact current / power: 6A, 30VDC; 1500VA, 250VAC • Max. continuous current: 2Arms (cos Φ = 1), 1Arms (cos Φ = 0.4) • Minimum load: 500mW (12V, 10mA) • Contact material: Silver-nickel (AgN) • Isolation between relay digital outputs, test voltage: 2.5kVrms, 1 minute
Cable Specifications	See section Control Terminals table.

5.2 Selecting the Control Cables

5.2.1 General Rules

Use multi-core cables with a braided copper wire shield, temperature rated at 60°C (140°F) or above:

Figure 5-1



Double shielded
Example: JAMAK by Draka NK Cables

Single shielded
Example: NOMAK by Draka NK Cables

For digital and analog I/O cables, twist the shield together into a bundle (pig-tail) not longer than five times its width and connect it to terminal X1-1 at the drive end. Leave the other end of the cable shield unconnected.

For connecting the shield wires of the RS485 cable, see the instructions (and notes) in section Mechanical and electrical installation – EFB.

Route control cables to minimize radiation to the cable:

- Route as far away as possible from the input power and motor cables (at least 20cm [8 in]).
- Where control cables must cross power cables, make sure they are at an angle as near 90° as possible.
- Stay at least 20cm (8 in) from the sides of the drive.

Use care in mixing signal types on the same cable:

- Do not mix relay-controlled signals using more than 30V and other control signals in the same cable.
- Run relay-controlled signals as twisted pairs (especially if voltage > 48V). Relay-controlled signals using less than 48V can be run in the same cables as digital input signals.

Note: Never mix 24VDC and 115/230VAC signals in the same cable.

5.2.1.1 Analog Cables

Recommendations for analog signal runs:

- Use double shielded, twisted pair cable.
- Use one individually shielded pair for each signal.
- Do not use a common return for different analog signals.

5.2.1.2 Digital Cables

Recommendation for digital signal runs: A double shielded cable is the best alternative, but single-shielded, twisted, multi pair cable is also usable.

5.2.1.3 Keypad Cable

If the keypad is connected to the drive with a cable, use only Category 5 Patch Ethernet cable. The maximum length that is tested to meet EMC specifications is 3 m (9.8 ft). Longer cables are susceptible to electromagnetic noise and must be user-tested to verify that EMC requirements are met. Where long runs are required (especially for runs longer than about 12 m [40 ft]), use a RS232/RS485 converter at each end and run RS485 cable.

5.2.2 Drive's Control Connection Terminals

The following table provides specifications for the drive's control terminals

Table 5-2

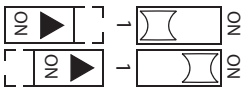
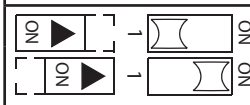
Frame Size	Control			
	Maximum Wire Size [1]		Tightening Torque	
	mm^2	AWG	N-m	lb-ft
All	1.5	16	0.4	0.3

[1] Values given for solid wires.
For stranded wires, the maximum size is 1 mm^2.

5.2.3 Control Terminals Table

The following provides information for connecting control wiring at X1 on the drive.

Table 5-3

	X1		Hardware Description
Analog I/O	1	SCR	Terminal for signal cable shield (screen). (Connected internally to chassis ground.)
	2	AI1	Analog input channel 1, programmable. Default[2] = frequency reference. Resolution 0.1%, accuracy ±1.
			Two different DIP switch types can be used.
			 J1: AI1 OFF: 0 - 10V (R_i = 312 kohm)
			J1: AI1 ON: 0 - 20mA (R_i = 100 kohm)
	3	AGND	Analog input circuit common (connected internally to chassis gnd. through 1 Mohm.)
	4	+10V	Potentiometer reference source: 10V ±2%, max. 10mA (1 kohm ≤ R ≤ 10 kohm.)
	5	AI2	Analog input channel 2, programmable. Default[2] = not used. Resolution 0.1%, accuracy ±1%.
			Two different DIP switch types can be used.
			 J1: AI2 OFF: 0 - 10V (R_i = 312 kohm)
			J1: AI2 ON: 0 - 20mA (R_i = 100 kohm)
	6	AGND	Analog input circuit common (connected internally to chassis gnd. through 1 Mohm).
	7	AO1	Analog output, programmable. Default[2] = frequency. 0 - 20mA (load < 500 ohm). Accuracy ±3%.
	8	AO2	Analog output, programmable. Default[2] = current. 0 - 20mA (load < 500 ohm). Accuracy ±3%.
	9	AGND	Analog output circuit common (connected internally to chassis gnd. through 1 Mohm).
Digital Inputs[1]	10	+24V	Auxiliary voltage output 24VDC / 250mA (reference to GND), short circuit protected.
	11	GND	Auxiliary voltage output common (connected internally as floating).
	12	DCOM	Digital input common. To activate a digital input, there must be ≥ +10V (or ≤ -10V) between that input and DCOM. The 24V may be provided be the ACB530 (X1-10) or be an external 12 - 24V source of either polarity.
	13	DI1	Digital input 1, programmable. Default[2] = start/stop.
	14	DI2	Digital input 2, programmable. Default[2] = fwd/rev.
	15	DI3	Digital input 3, programmable. Default[2] = constant speed sel (code).
	16	DI4	Digital input 4, programmable. Default[2] = constant speed sel (code).
	17	DI5	Digital input 5, programmable. Default[2] = ramp pair selection (code).
	18	DI6	Digital input 6, programmable. Default[2] = not used.

Relay Outputs	19	RO1C		Relay output 1, programmable. Default[2] = ready.
	20	RO1A		Maximum: 250VAC / 30VDC, 2A
	21	RO1B		Minimum: 500mW (12V, 10mA)
	22	RO2C		Relay output 2, programmable. Default[2] = running.
	23	RO2A		Maximum: 250VAC / 30VDC, 2A
	24	RO2B		Minimum: 500mW (12V, 10mA)
	25	RO3C		Relay output 3, programmable. Default[2] = fault (-1).
	26	RO3A		Maximum: 250VAC / 30VDC, 2A
	27	RO3B		Minimum: 500mW (12V, 10mA)

[1] Digital input impedance 1.5 kohm. Maximum voltage for digital inputs is 30V.

[2] Default values depend on the operating mode used. Values specified are for the default operating mode. See Application Operation Modes.

Note: Terminals 3, 6 and 9 are at the same potential.

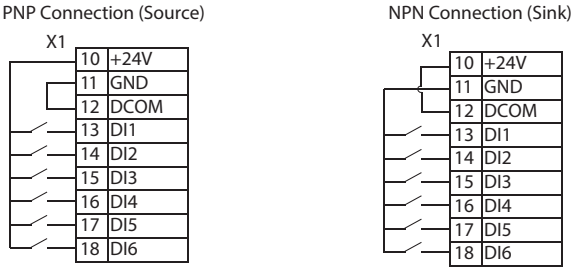
Note: For safety reasons the fault relay signals a “fault” when the ACB530 is powered down.

WARNING! All ELV (Extra Low Voltage) circuits connected to the drive must be used within a zone of equipotential bonding, i.e. within a zone where all simultaneously accessible conductive parts are electrically connected to prevent hazardous voltages appearing between them. This is accomplished by a proper factory grounding.

The terminals on the control board as well as on the optional modules attachable to the board fulfil the Protective Extra Low Voltage (PELV) requirements stated in EN50178, provided that the external circuits connected to the terminals also fulfil the requirements and the installation site is below 2000m (6562 ft).

You can wire the digital input terminals in either a PNP or NPN configuration.

Figure 5-2

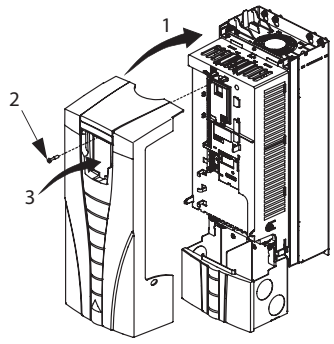


5.3 Reinstall the Cover

5.3.1 IP21 / UL Type 1

1. Align the cover and slide it on.
2. Tighten the captive screw.
3. Reinstall the keypad.
4. Continue with start-up. See chapter Start-up, control with I/O and ID Run.

Figure 5-3



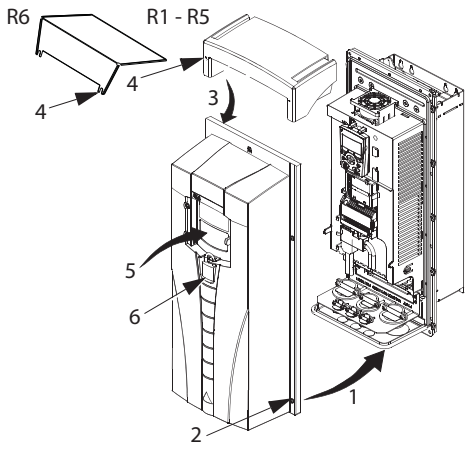
5.3.2 IP54 / UL Type 12

1. Align the cover and slide it on.
2. Tighten the captive screws around the edge of the cover.
3. Slide the hood down over the top of the cover. (Only needed for UL type 12 installations.)
4. Install the two screws that attach the hood. (Only needed for UL type 12 installations.)
5. Install the keypad.

Note: The keypad window must be closed to comply with IP54 / UL type 12.

6. Optional: Add a lock (not supplied) to secure the keypad window.
7. Continue with start-up. See chapter Start-up, control with I/O and ID Run.

Figure 5-4



5.4 Application Operating Modes

Operating modes change a group of parameters to new, predefined values. Use operating modes to minimize the need for manual editing of parameters. Selecting an operating mode sets all other parameters to their default values, except:

- Group: START-UP DATA parameters (except parameter 9904)
- 1602 PARAMETER LOCK
- 1607 PARAM SAVE
- 3018 COMM FAULT FUNC and 3019 COMM FAULT TIME
- 9802 COMM PROT SEL
- Group 51: EXT COMM MODULE through Group 53: EFB PROTOCOL parameters

After selecting an operating mode, you can make additional parameter changes manually with the keypad.

You enable application operating modes by setting the value for parameter 9902 APPLIC OPERATING MODE. By default, 1, ABB 2-Wire, is the enabled operating mode.

The following sections describe each of the application operating modes and provide a connection example for each operating mode.

The last section in this chapter, Operating mode default values for parameters, lists the parameters that the operating modes change and the default values established by each operating mode.

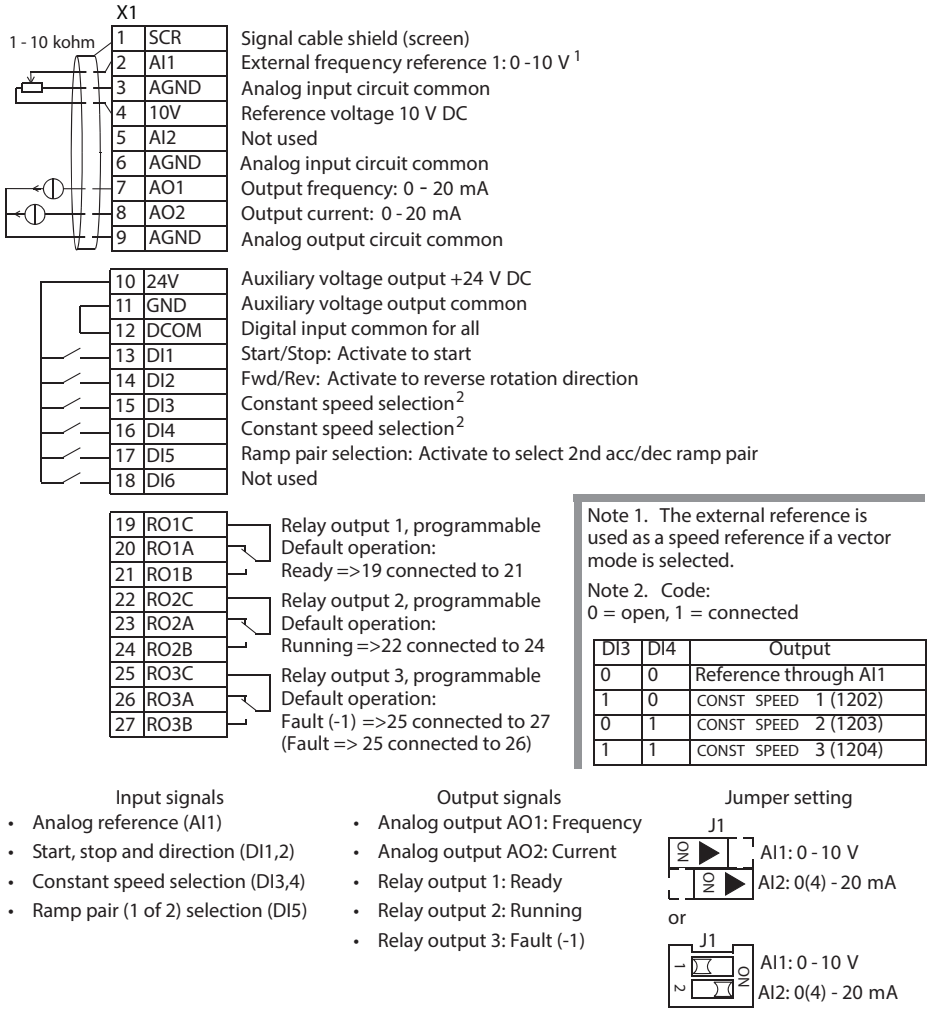
The ACB530 has six standard Operating Modes. The table below provides a summary of the Operating Modes and describes typical applications.

Macro	Suitable applications
ABB 2-wire	Ordinary speed control applications where no, one, two or three constant speeds are used. Start/stop is controlled with one digital input (level start and stop). It is possible to switch between two acceleration and deceleration times.
ABB 3-wire	Ordinary speed control applications where no, one, two or three constant speeds are used. The drive is started and stopped with push buttons.
Baldor 2-wire	Speed control applications where no, one, two or three constant speeds are used. Start, stop and direction are controlled by two digital inputs (combination of the input states determines the operation).
Motor potentiometer	Speed control applications where no or one constant speed is used. The speed is controlled by two digital inputs (increase / decrease / keep unchanged).
Hand/Auto	Speed control applications where switching between two control devices is needed. Some control signal terminals are reserved for one device, the rest for the other. One digital input selects between the terminals (devices) in use.
PID control	Process control applications, for example different closed loop control systems such as pressure control, level control and flow control. It is possible to switch between process and speed control: Some control signal terminals are reserved for process control, others for speed control. One digital input selects between process and speed control.

5.4.1 ABB 2-Wire Operating Mode

This is the default operating mode. It provides a general purpose, 2-wire I/O configuration, with three (3) constant speeds. Parameter values are the default values defined in section Complete parameter list.

Figure 5-5 ABB 2-Wire Operating Mode Connection Example

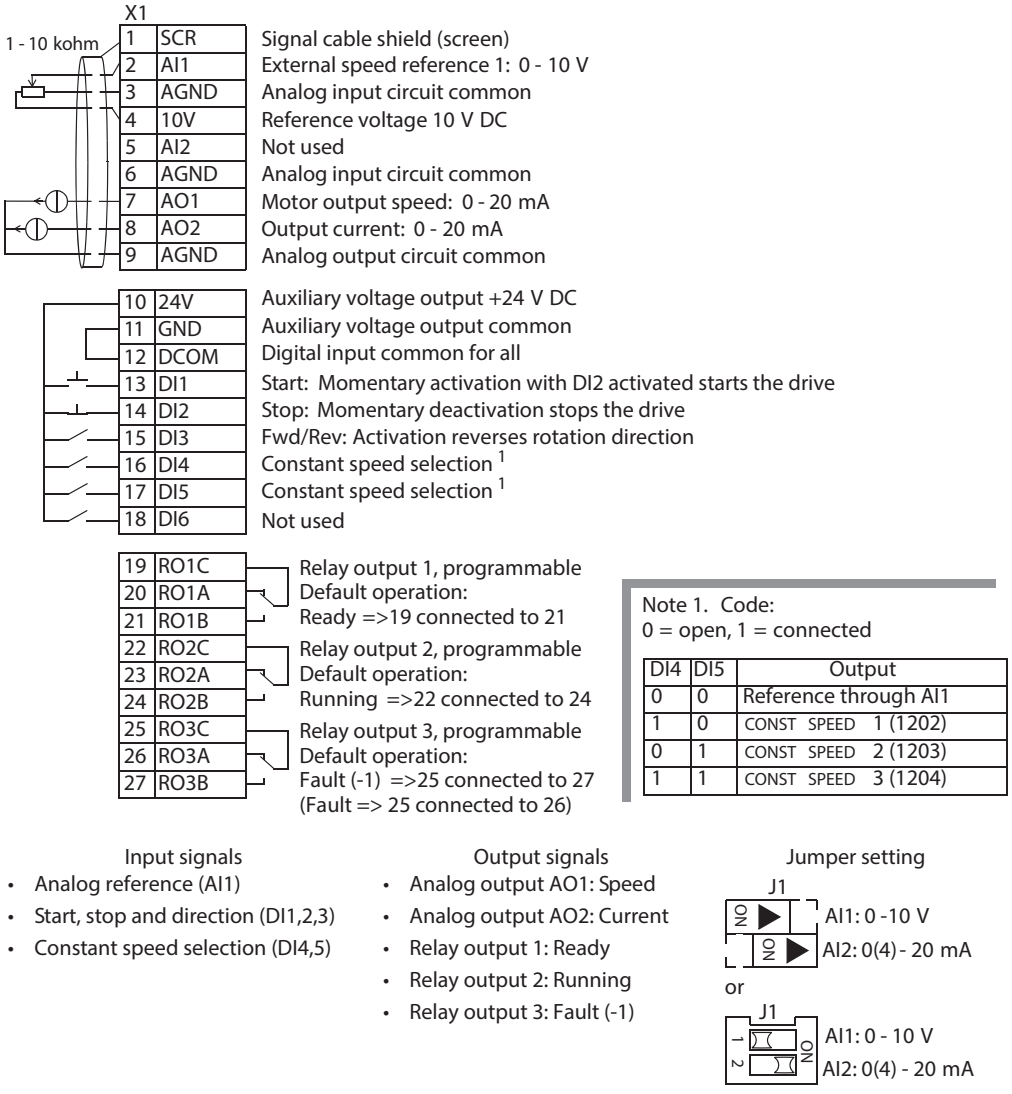


5.4.2 ABB 3-Wire Operating Mode

This operating mode is used when the drive is controlled using momentary push-buttons. It provides three (3) constant speeds. To enable, set the value of parameter 9902 to 2(3-WIRE).

Note: When the stop input (DI2) is deactivated (no input), the keypad start/stop buttons are disabled.

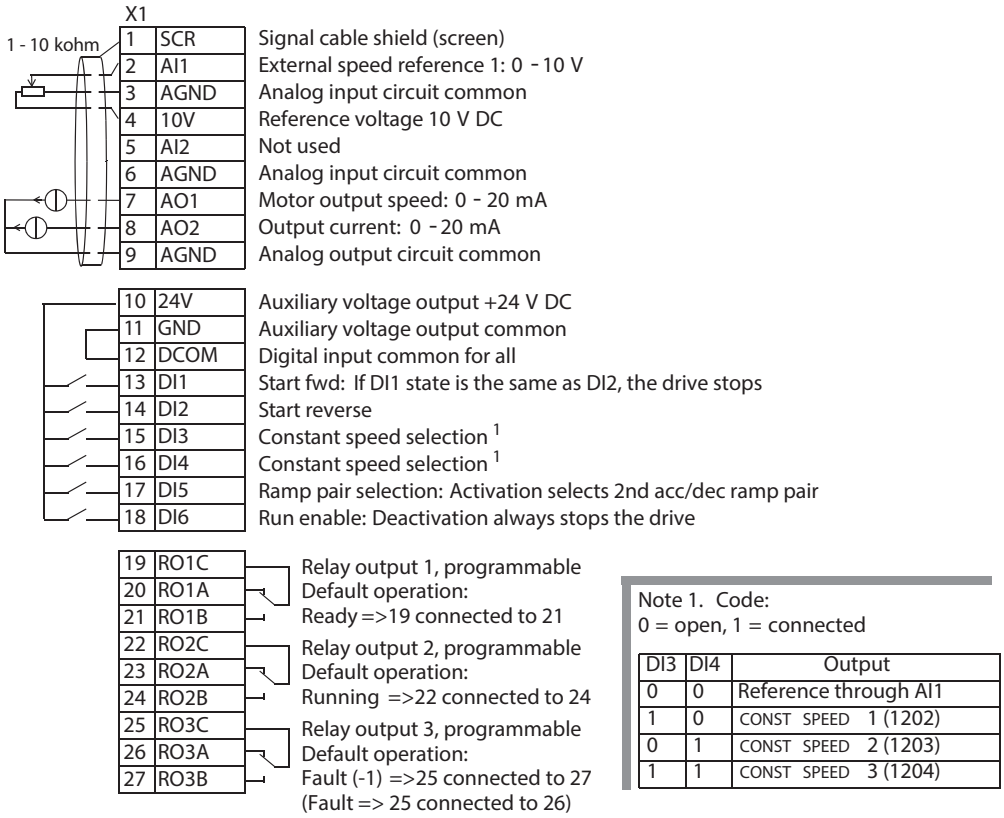
Figure 5-6 ABB 3-Wire Operating Mode Connection Example


X1
1 - 10 kohm
1 SCR Signal cable shield (screen)
2 AI1 External speed reference 1: 0 - 10 V
3 AGND Analog input circuit common
4 10V Reference voltage 10 V DC
5 AI2 Not used
6 AGND Analog input circuit common
7 AO1 Motor output speed: 0 - 20 mA
8 AO2 Output current: 0 - 20 mA
9 AGND Analog output circuit common
10 24V Auxiliary voltage output +24 V DC
11 GND Auxiliary voltage output common
12 DCOM Digital input common for all
13 DI1 Start: Momentary activation with DI2 activated starts the drive
14 DI2 Stop: Momentary deactivation stops the drive
15 DI3 Fwd/Rev: Activation reverses rotation direction
16 DI4 Constant speed selection 1
17 DI5 Constant speed selection 1
18 DI6 Not used
19 RO1C
20 RO1A
21 RO1B
Relay output 1, programmable
Default operation:
Ready =>19 connected to 21
22 RO2C
23 RO2A
24 RO2B
Relay output 2, programmable
Default operation:
Running =>22 connected to 24
25 RO3C
26 RO3A
27 RO3B
Relay output 3, programmable
Default operation:
Fault (-1) =>25 connected to 27
(Fault => 25 connected to 26)
Note 1. Code:
0 = open, 1 = connected
DI4 DI5 Output
0 0 Reference through AI1
1 0 CONST SPEED 1 (1202)
0 1 CONST SPEED 2 (1203)
1 1 CONST SPEED 3 (1204)
Input signals
• Analog reference (AI1)
• Start, stop and direction (DI1,2,3)
• Constant speed selection (DI4,5)
Output signals
• Analog output AO1: Speed
• Analog output AO2: Current
• Relay output 1: Ready
• Relay output 2: Running
• Relay output 3: Fault (-1)
Jumper setting
J1
ON
AI1: 0 -10 V
AI2: 0(4) - 20 mA
or
J1
1
2
ON
AI1: 0 - 10 V
AI2: 0(4) - 20 mA

5.4.3 Baldor 2-Wire Operating Mode

This operating mode provides an I/O configuration adopted to a sequence of DI control signals used when alternating the rotation direction of the motor. To enable, set the value of parameter 9902 to 3 (Baldor 2-Wire).

Figure 5-7 Baldor 2-Wire Operating Mode Connection Example



Note 1. Code:
0 = open, 1 = connected

DI3	DI4	Output
0	0	Reference through AI1
1	0	CONST SPEED 1 (1202)
0	1	CONST SPEED 2 (1203)
1	1	CONST SPEED 3 (1204)

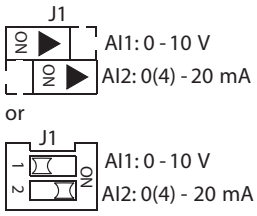
Input signals

- Analog reference (AI1)
- Start, stop and direction (DI1,2)
- Constant speed selection (DI3,4)
- Ramp pair 1/2 selection (DI5)
- Run enable (DI6)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

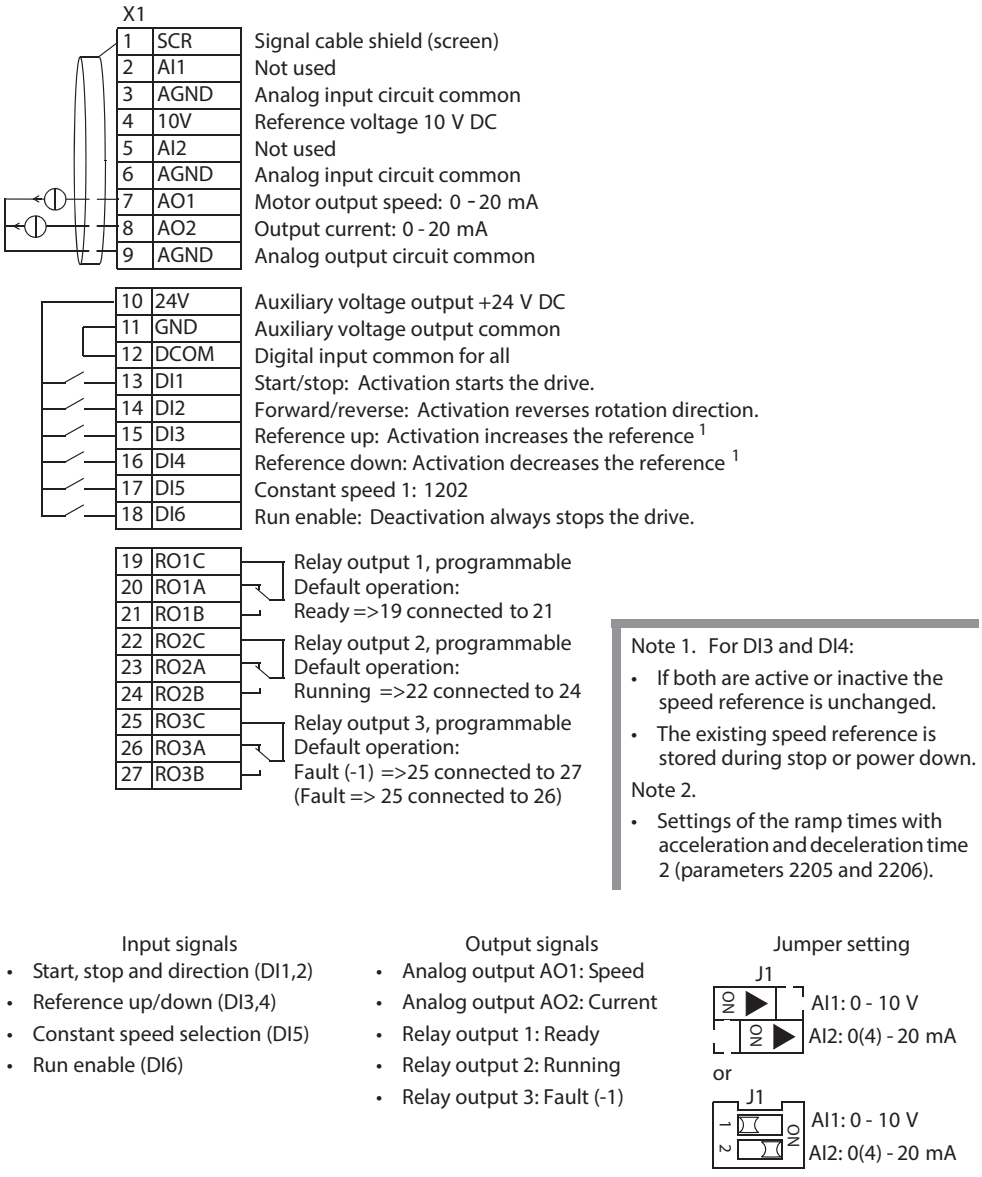
Jumper setting



5.4.4 Motor Potentiometer Operating Mode

This operating mode provides a cost-effective interface for PLCs that vary the speed of the motor using only digital signals. To enable, set the value of parameter 9902 to 4(MOTOR POT).

Figure 5-8 Motor Potentiometer Operating Mode Connection Example



Note 1. For DI3 and DI4:

- If both are active or inactive the speed reference is unchanged.
- The existing speed reference is stored during stop or power down.

Note 2.

- Settings of the ramp times with acceleration and deceleration time 2 (parameters 2205 and 2206).

Input signals

- Start, stop and direction (DI1,2)
- Reference up/down (DI3,4)
- Constant speed selection (DI5)
- Run enable (DI6)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

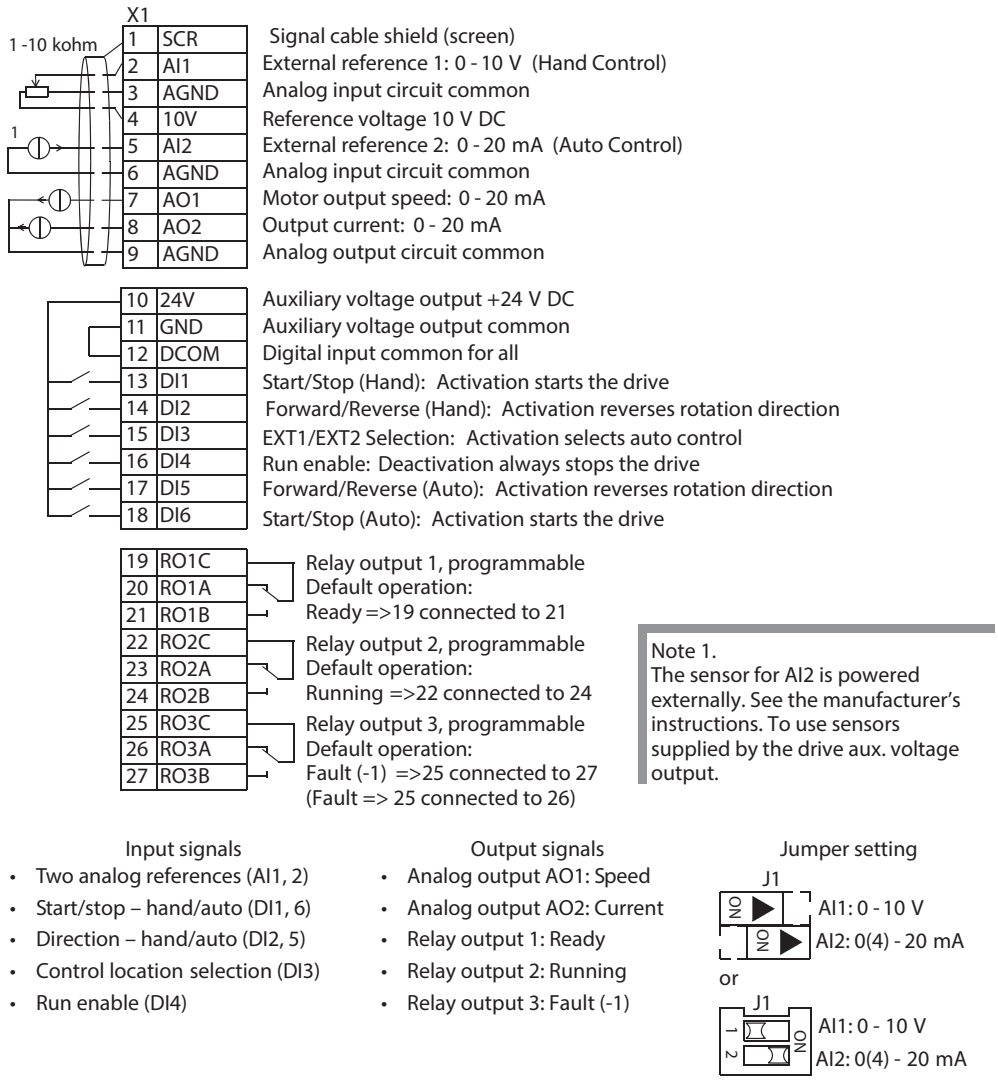
Jumper setting

5.4.5 Hand-Auto Operating Mode

This operating mode provides an I/O configuration that is typically used in HVAC applications. To enable, set the value of parameter 9902 to 5(HAND/AUTO).

Note: Parameter 2108 START INHIBIT must remain in the default setting, 0(OFF).

Figure 5-9 Hand-Auto Operating Mode Connection Example

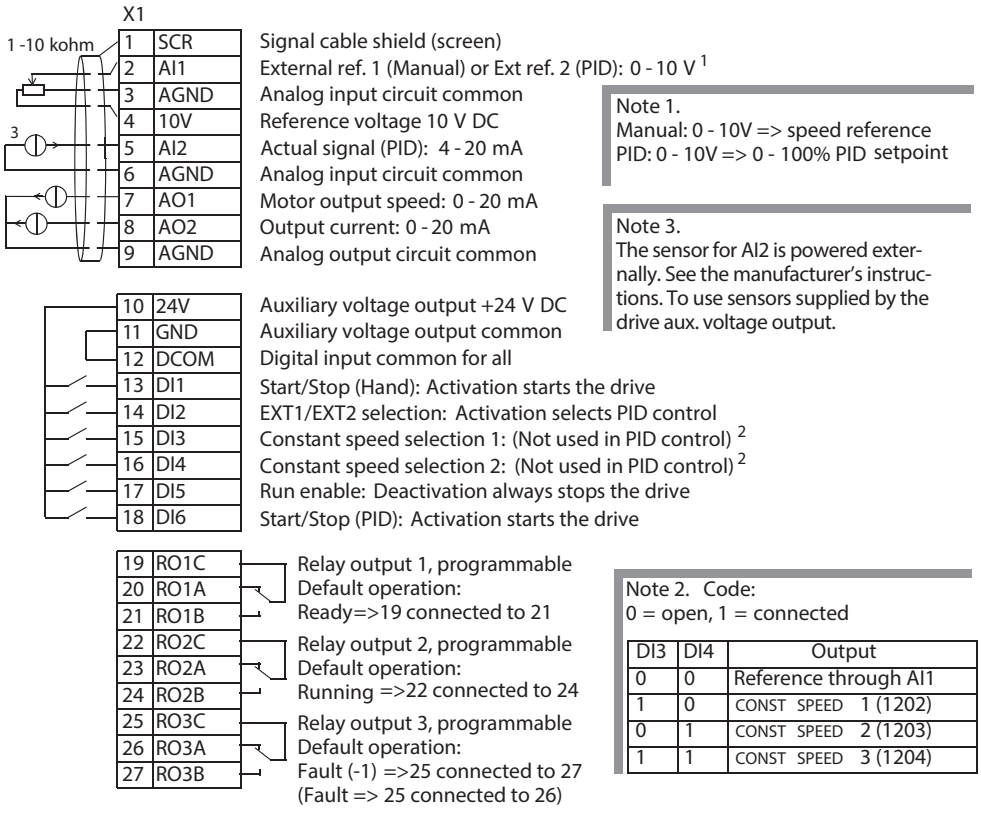


5.4.6 PID Control Operating Mode

This operating mode provides parameter settings for closed-loop control systems such as pressure control, flow control, etc. To enable, set the value of parameter 9902 to 6 (PROCESS CONTROL).

Note: Parameter 2108 START INHIBIT must remain in the default setting, 0(OFF).

Figure 5-10 PID Control Operating Mode Connection Example


X1
1 -10 kohm
3
1 SCR
2 AI1
3 AGND
4 10V
5 AI2
6 AGND
7 AO1
8 AO2
9 AGND
Signal cable shield (screen)
External ref. 1 (Manual) or Ext ref. 2 (PID): 0 - 10 V 1
Analog input circuit common
Reference voltage 10 V DC
Actual signal (PID): 4 - 20 mA
Analog input circuit common
Motor output speed: 0 - 20 mA
Output current: 0 - 20 mA
Analog output circuit common
Note 1.
Manual: 0 - 10V => speed reference
PID: 0 - 10V => 0 - 100% PID setpoint
Note 3.
The sensor for AI2 is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output.
10 24V
11 GND
12 DCOM
13 DI1
14 DI2
15 DI3
16 DI4
17 DI5
18 DI6
Auxiliary voltage output +24 V DC
Auxiliary voltage output common
Digital input common for all
Start/Stop (Hand): Activation starts the drive
EXT1/EXT2 selection: Activation selects PID control
Constant speed selection 1: (Not used in PID control) 2
Constant speed selection 2: (Not used in PID control) 2
Run enable: Deactivation always stops the drive
Start/Stop (PID): Activation starts the drive
19 RO1C
20 RO1A
21 RO1B
22 RO2C
23 RO2A
24 RO2B
25 RO3C
26 RO3A
27 RO3B
Relay output 1, programmable
Default operation:
Ready=>19 connected to 21
Relay output 2, programmable
Default operation:
Running =>22 connected to 24
Relay output 3, programmable
Default operation:
Fault (-1) =>25 connected to 27
(Fault => 25 connected to 26)
Note 2. Code:
0 = open, 1 = connected
DI3 DI4 Output
0 0 Reference through AI1
1 0 CONST SPEED 1 (1202)
0 1 CONST SPEED 2 (1203)
1 1 CONST SPEED 3 (1204)

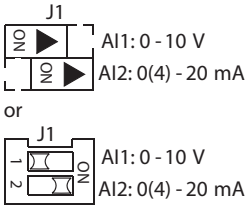
Input signals

- Analog reference (AI1)
- Actual value (AI2)
- Start/stop – hand/PID (DI1, 6)
- EXT1/EXT2 selection (DI2)
- Constant speed selection (DI3, 4)
- Run enable (DI5)

Output signals

- Analog output AO1: Speed
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Jumper setting



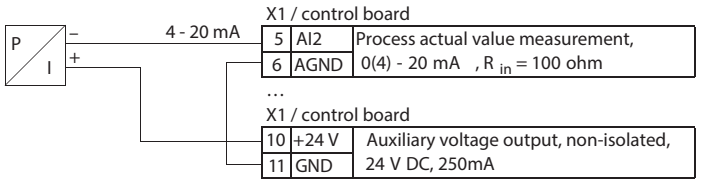
Note: Use the following switch-on order:

1. EXT1/EXT2
2. Run Enable
3. Start.

5.5 Connection Examples of Two-Wire and Three-Wire Sensors

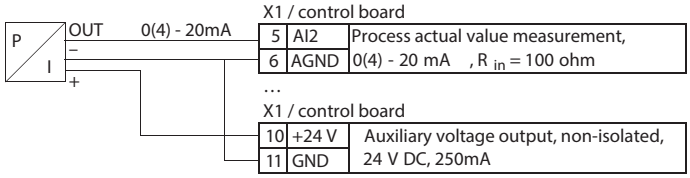
Many applications use process PI(D) and need a feedback signal from the process. The feedback signal is typically connected to analog input 2(AI2). The operating mode wiring diagrams for each operating mode in this chapter use an externally powered sensor (connections not shown). The figures below give examples of connections using a two-wire or three-wire sensor/transmitter supplied by the drive auxiliary voltage output.

Figure 5-11 Two-Wire Sensor/Transmitter


P
I
–
+
4 - 20 mA
X1 / control board
5 AI2 Process actual value measurement,
6 AGND 0(4) - 20 mA , R in = 100 ohm
…
X1 / control board
10 +24 V Auxiliary voltage output, non-isolated,
11 GND 24 V DC, 250mA

Note: The sensor is supplied through its current output and the drive feeds the supply voltage (+24V).Thus the output signal must be 4 - 20mA, not 0 - 20mA.

Figure 5-12 Three-Wire Sensor/Transmitter



5.6 Operating Mode Default Values for Parameters

Parameter default values are listed in section Complete parameter list. Changing from the default operating mode (ABB Standard), that is, editing the value of parameter 9902, changes the parameter default values as defined in the following table.

Table 5-4

Parameter		ABB 2-Wire	ABB 3-Wire	Baldor 2-Wire	Motor Potentiometer	Hand-Auto	PID Control
9902	Operating Mode	1 = ABB 2-WIRE	2 = ABB 3-WIRE	3 = BALDOR 2-WIRE	4 = MOTOR POT	5 = HAND/AUTO	6 = PID CONTROL
9904	Control Type	2 = V/F CONTROL	1 = OPEN VECTOR	1 = OPEN VECTOR	1 = OPEN VECTOR	1 = OPEN VECTOR	1 = OPEN VECTOR
1001	EXT1 COMMANDS	2 = DI1,2	4 = DI1P,2P,3	9 = DI1F, 2R	2 = DI1,2	2 = DI1,2	1 = DI1
1002	EXT2 COMMANDS	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL	7 = DI6,5	6 = DI6,5
1003	DIRECTION	3 = REQUEST	3 = REQUEST	3 = REQUEST	3 = REQUEST	3 = REQUEST	1 = FORWARD
1102	EXT1/EXT2 SEL	0 = EXT1	0 = EXT1	0 = EXT1	0 = EXT1	3 = DI3	2 = DI2
1103	RE1 SELECT	1 = AI1	1 = AI1	1 = AI1	12 = DI3U,4D(NC)	1 = AI1	1 = AI1
1106	REF2 SELECT	2 = AI2	2 = AI2	2 = AI2	2 = AI2	2 = AI2	19 = PID1OUT
1201	CONST SPEED SEL	9 = DI3,4	10 = DI4.5	9 = DI3,4	5 = DI5	0 = NOT SEL	9 = DI3,4
1304	MINIMUM AI2	0.0%	0.0%	0.0%	0.0%	20.0%	20.0%
1401	RELAY OUTPUT 1	1 = READY	1 = READY	1 = READY	1 = READY	1 = READY	1 = READY
1402	RELAY OUTPUT 2	2 = RUN	2 = RUN	2 = RUN	2 = RUN	2 = RUN	2 = RUN
1403	RELAY OUTPUT 3	3 = FAULT(-1)	3 = FAULT(-1)	3 = FAULT(-1)	3 = FAULT(-1)	3 = FAULT(-1)	3 = FAULT(-1)
1501	AO1 CONTENT SEL	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED
1507	AO2 CONTENT SEL	104 = CURRENT	104 = CURRENT	104 = CURRENT	104 = CURRENT	104 = CURRENT	104 = CURRENT
1510	MINIMUM AO2	0.0mA	0.0mA	0.0mA	0.0mA	0.0mA	0.0mA
1601	RUN ENABLE	0 = NOT SEL	0 = NOT SEL	6 = DI6	6 = DI6	4 = DI4	5 = DI5
2201	ACC/DEC 1/2 SEL	5 = DI5	0 = NOT SEL	5 = DI5	0 = NOT SEL	0 = NOT SEL	0 = NOT SEL
3201	SUPERV 1 PARAM	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED
3401	SIGNAL 1 PARAM	103 = 0103 OUTPUT FREQ	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED	102 = 0102 SPEED
4001	GAIN	1.0	1.0	1.0	1.0	1.0	1.0
4002	INTEGRATION TIME	60.0 s	60.0 s	60.0 s	60.0 s	60.0 s	60.0 s

Chapter 6
Using the Keypad

6.1 Keypads

6.1.1 About Keypads

Use a keypad to control the drive, read status data and adjust parameters.

- Assistant Keypad – This keypad (described below) includes pre-programmed assistants to automate the most common parameter setups. The keypad provides language support. It is available with different language sets.

The manual is applicable to keypads with the keypad revisions and the keypad firmware versions given in the table below

Keypad Type	Type Code	Keypad Revision	Keypad Firmware Version
Assistant Keypad	ACB-CP-BA	F or later	2.04 or later

To find out the keypad revision, see the label on the back of the keypad. An example label and explanation of the label contents are shown below.

1	Keypad type code	
2	Serial number of format MYYWWRXXXX, where	
	M:	Manufacturer
	YY:	09, 10, 11, …, for 2009, 2010, 2011, …
	WW:	01, 02, 03, … for week 1, week 2, week 3, …
	R:	A, B, C, … for keypad revision
	XXXX:	Integer starting every week from 0001
3	RoHS mark	(the label of your drive shows the valid markings)

To find out the keypad firmware version of your assistant keypad.

See parameter 9901 LANGUAGE to find out the languages supported by the assistant keypad.

6.2 Assistant Keypad

6.2.1 Features

The assistant keypad features:

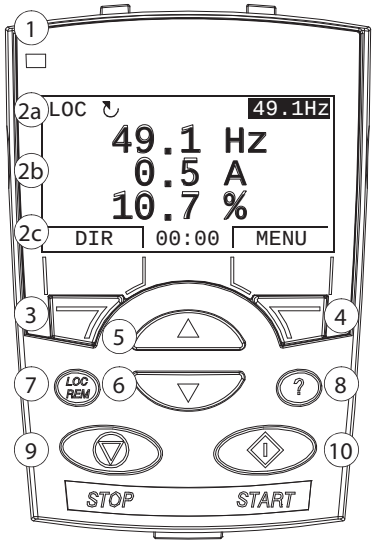
- alpha numeric keypad with an LCD display
- language selection for the display
- start-up assistant to ease drive commissioning
- copy function – parameters can be copied to the keypad memory for later transfer to other drives or for backup of a particular system
- context-sensitive help
- real time clock

6.2.2 Overview

The following table summarizes the key functions and displays on the assistant keypad.

No.	Use
1	Status LED – Green for normal operation. If LED is flashing, or red, see section LED Descriptions.
2	LCD display – Divided into three main areas: a. Status line – variable, depending on the mode of operation, see section Status line. b. Center – variable; in general, shows signal and parameter values, menus or lists. Shows also faults and alarms. c. Bottom line – shows current functions of the two soft keys and, if enabled, the clock display.
3	Soft key 1 – Function depends on the context. The text in the lower left corner of the LCD display indicates the function.
4	Soft key 2 – Function depends on the context. The text in the lower right corner of the LCD display indicates the function.
5	Up – • Scrolls up through a menu or list displayed in the center of the LCD display. • Increments a value if a parameter is selected. • Increments the reference value if the upper right corner is highlighted. Holding the key down changes the value faster.
6	Down – • Scrolls down through a menu or list displayed in the center of the LCD display. • Decrements a value if a parameter is selected. • Decrements the reference value if the upper right corner is highlighted. Holding the key down changes the value faster.
7	LOC/REM – Changes between local and remote control of the drive.
8	Help – Displays context-sensitive information when the key is pressed. The information displayed describes the item currently highlighted in the center of the display.
9	STOP – Stops the drive in local control.
10	START – Starts the drive in local control.

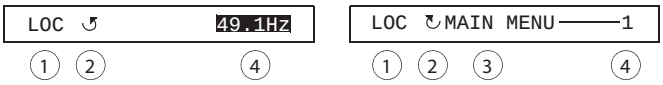
Figure 6-1 Assistant Keypad



6.2.3 Status Line

The top line of the LCD display shows the basic status information of the drive.

Figure 6-2 Status Line



No.	Field	Alternatives	Significance
1	Control location	LOC	Drive control is local, that is, from the keypad.
		REM	Drive control is remote, such as the drive I/O or fieldbus.
2	State	↻	Forward shaft direction.
		↺	Reverse shaft direction.
		Rotating arrow	Drive is running at setpoint.
		Dotted rotating arrow	Drive is running but not at setpoint.
		Stationary arrow	Drive is stopped.
		Dotted stationary arrow	Start command is present, but the motor is not running, e.g. because start enable is missing.
3	Keypad operation mode		• Name of the current mode. • Name of the list or menu shown. • Name of the operation state, eg PAR EDIT.
4	Reference value or number of the selected item		• Reference value in the Output mode. • Number of the highlighted item, e.g. mode, parameter group or fault.

6.2.4 Operation

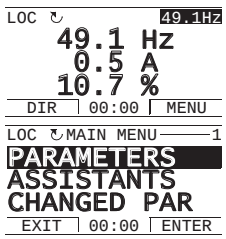
You operate the keypad with menus and keys. The keys include two context-sensitive soft keys, whose current function is indicated by the text shown in the display above each key.

You select an option, e.g. operation mode or parameter, by scrolling the ▲ and ▼ arrow keys until the option is highlighted and then pressing the relevant soft key. With the right soft key you usually enter a mode, accept an option or save the changes. The left soft key is used to cancel the made changes and return to the previous operation level.

The assistant keypad has nine keypad modes: Output mode, Parameter mode, Assistants mode, Changed parameters mode, Fault logger mode, Time and date mode, Parameter backup mode, I/O settings mode and Fault mode. The operation in the first eight modes is described in this chapter. When a fault or alarm occurs, the panel goes automatically to the Fault mode showing the fault or alarm. You can reset it in the Output or Fault mode (see chapter 9 - Troubleshooting and Maintenance).

Initially, the keypad is in the Output mode, where you can start, stop, change the direction, switch between local and remote control, modify the reference value and monitor up to three actual values.

To do other tasks, go first to the Main menu and select the appropriate mode on the menu. The status line (see section Status line) shows the name of the current menu, mode, item or state.



6.2.4.1 How to do Common Tasks

The table below lists common tasks, the mode in which you can perform them and the page number where the steps to do the task are described in detail.

Task	Mode	Section
How to get help	Any	6.2.4.2
How to find out the keypad version	At power up	6.2.4.3
How to adjust the display contrast	Output	6.2.5.3
How to switch between local and remote control	Any	6.2.4.4
How to start and stop the drive	Any	6.2.4.4
How to change the direction of the motor rotation	Output	6.2.5.1
How to set the speed, frequency or torque reference	Output	6.2.5.2
How to change the value of a parameter	Parameters	6.2.6.1
How to select the monitored signals	Parameters	6.2.6.2
How to do guided tasks (specification of related parameter sets) with assistants	Assistants	6.2.7.1
How to view and edit changed parameters	Changed parameters	6.2.8.1
How to view faults	Fault logger	6.2.9.1
How to reset faults and alarms	Output, Fault	Chapter 9
How to show/hide the clock, change date and time formats, set the clock and enable/disable automatic clock transitions according to the daylight saving changes	Time and date	6.2.10.1
How to copy parameters from the drive to the keypad	Parameter backup	6.2.11.1
How to restore parameters from the keypad to the drive	Parameter backup	6.2.11.1
How to view backup information	Parameter backup	6.2.11.2
How to edit and change parameter settings related to I/O terminals	I/O settings	6.2.12.1

6.2.4.2 How to Get Help

Step	Action	Display
1	Press ? to read the context-sensitive help text for the item that is highlighted. If help text exists for the item, it is shown on the display.	LOC ↻PAR GROUPS——10 01 OPERATING DATA 03 FB ACTUAL SIGNALS 04 FAULT HISTORY 10 START/STOP/DIR 11 REFERENCE SELECT EXIT | 00:00 | SEL LOC ↻HELP—— This group defines external sources (EXT1 and EXT2) for commands that enable start, stop and EXIT | 00:00 |
2	If the whole text is not visible, scroll the lines with keys ▲ and ▼.	LOC ↻HELP—— external sources (EXT1 and EXT2) for commands that enable start, stop and direction changes. EXIT | 00:00 |
3	After reading the text, return to the previous display by pressing EXIT.	LOC ↻PAR GROUPS——10 01 OPERATING DATA 03 FB ACTUAL SIGNALS 04 FAULT HISTORY 10 START/STOP/DIR 11 REFERENCE SELECT EXIT | 00:00 | SEL

6.2.4.3 How to Find out the Panel Version

Step	Action	Display
1	If the power is switched on, switch it off	
2	Keep key ? pressed down while you switch on the power and read the information. The display shows the following keypad information: Panel SW: keypad firmware version ROM CRC: keypad ROM check sum Flash Rev: flash content version Flash content comment. When you release the ? key, the panel goes to the Output mode.	PANEL VERSION INFO Panel FW: x.xx ROM CRC: xxxxxxxxxx Flash Rev: x.xx xxxxxxxxxxxxxxxxxxxx

6.2.4.4 How to Start, Stop and Switch Between Local and Remote Control

You can start, stop and switch between local and remote control in any mode. To be able to start or stop the drive, the drive must be in local control.

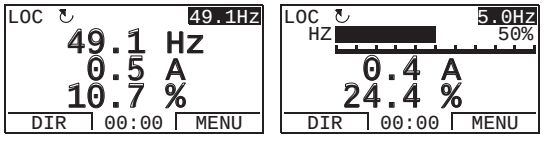
Step	Action	Display
1	• To switch between remote control (REM shown on the status line) and local control (LOC shown on the status line), press LOC/REM . **Note:** Switching to local control can be disabled with parameter 1606 LOCAL LOCK. The very first time the drive is powered up, it is in remote control (REM) and controlled through the drive I/O terminals. To switch to local control (LOC) and control the drive using the keypad, press LOC/REM . The result depends on how long you press the key: • If you release the key immediately (the display flashes “Switching to the local control mode”), the drive stops. Set the local control reference. • If you press the key for about two seconds, the drive continues as before. The drive copies the current remote values for the run/stop status and the reference, and uses them as the initial local control settings. • To stop the drive in local control, press STOP . • To start the drive in local control, press START .	LOC ↻ MESSAGE Switching to the local control mode. 00:00 The arrow (↻ or ↺) on the status line stops rotating. The arrow (↻ or ↺) on the status line starts rotating. It is dotted until the drive reaches the setpoint.

6.2.5 Output Mode

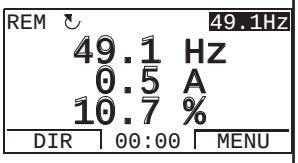
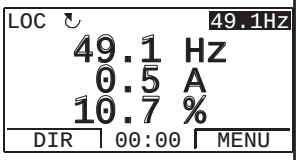
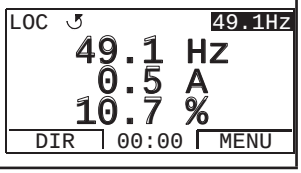
In the Output mode, you can:

- monitor actual values of up to three signals in group 01 OPERATING DATA
- change the direction of the motor rotation
- set the speed, frequency or torque reference
- adjust the display contrast
- start, stop, change the direction and switch between local and remote control.

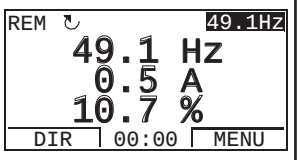
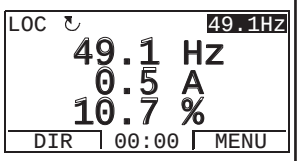
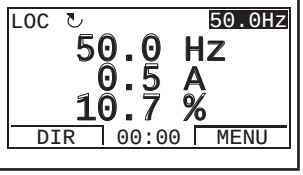
You get to the Output mode by pressing EXIT repeatedly.

The top right corner of the display shows the reference value. The center can be configured to show up to three signal values or bar graphs. If just one or two signals are selected for display, the number and name of each displayed signal are shown in addition to the value or bar graph. See instructions on selecting and modifying the monitored signals in parameters 3401 - 3421 in Chapter 7.	

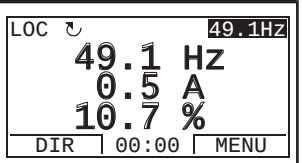
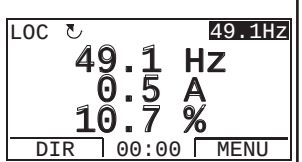
6.2.5.1 How to Change the Direction of the Motor Rotation

Step	Action	Display
1	If you are not in the Output mode, press EXIT repeatedly until you get there.	
2	If the drive is in remote control (REM shown on the status line), switch to local control by pressing LOC/REM. The display briefly shows a message about changing the mode and then returns to the Output mode.	
3	To change the direction from forward (↻ shown on the status line) to reverse (↺ shown on the status line), or vice versa, press DIR. **Note:** Parameter 1003 DIRECTION must be set to 3 (REQUEST).	

6.2.5.2 How to Set the Speed, Frequency or Torque Reference

Step	Action	Display
1	If you are not in the Output mode, press EXIT repeatedly until you get there.	
2	If the drive is in remote control (REM shown on the status line), switch to local control by pressing LOC/REM. The display briefly shows a message about changing the mode and then returns to the Output mode. **Note:** With group 11 REFERENCE SELECT, you can allow the reference modification in remote control.	
3	• To increase the highlighted reference value shown in the top right corner of the display, press ▲. The value changes immediately. It is stored in the drive permanent memory and restored automatically after power switch-off. • To decrease the value, press ▼.	

6.2.5.3 How to Adjust the Display Contrast

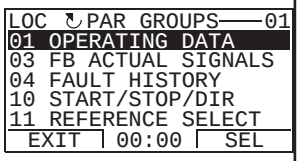
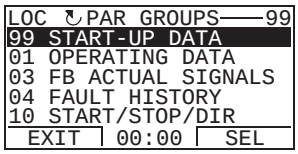
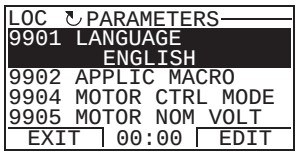
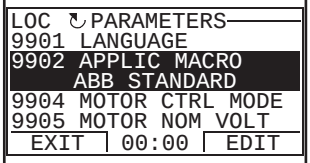
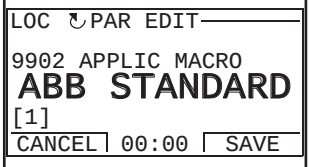
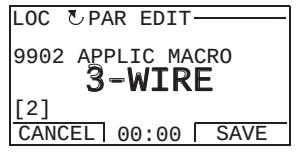
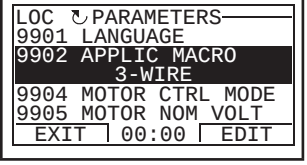
Step	Action	Display
1	If you are not in the Output mode, press EXIT repeatedly until you get there.	
2	• To increase the contrast, press MENU keys and ▲ simultaneously. • To decrease the contrast, press MENU keys and ▼ simultaneously.	

6.2.6 Parameter Mode

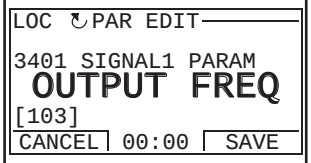
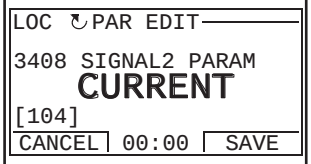
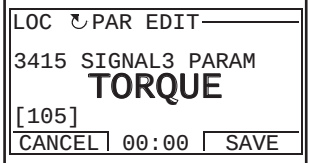
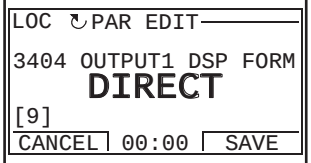
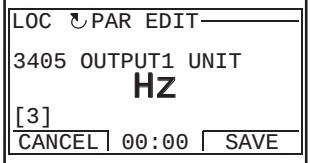
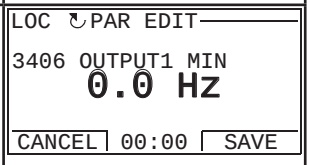
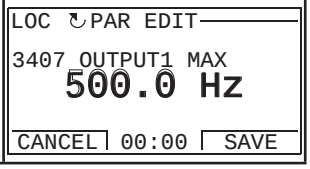
In the Parameter mode, you can:

- view and change parameter values
- start, stop, change the direction and switch between local and remote control.

6.2.6.1 How to Select a Parameter and Change its Value

Step	Action	Display
1	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing EXIT repeatedly until you get to the Main menu.	
2	Go to the Parameters mode by selecting PARAMETERS on the menu with keys ▲ and ▼, and pressing ENTER.	
3	Select the appropriate parameter group with keys ▲ and ▼. Press SEL.	 
4	Select the appropriate parameter with keys ▲ and ▼. The current value of the parameter is shown below the selected parameter. Press EDIT.	 
5	Specify a new value for the parameter with keys ▲ and ▼. Pressing the key once increments or decrements the value. Holding the key down changes the value faster. Pressing the keys simultaneously replaces the displayed value with the default value.	
6	• To save the new value, press SAVE. • To cancel the new value and keep the original, press CANCEL.	

6.2.6.2 How to Select the Monitored Signals

Step	Action	Display
1	You can select which signals are monitored in the Output mode and how they are displayed with group PANEL DISPLAY parameters. See detailed instructions on changing parameter values. By default, the display shows three signals. The particular default signals depend on the value of parameter 9902 Operating Mode: For operating modes whose default value of parameter 9904 Control Type is 1 (Open Vector), the default for signal 1 is 0102 SPEED, otherwise 0103 OUTPUT FREQ. The defaults for signals 2 and 3 are always 0104 CURRENT and 0105 TORQUE, respectively. Signal 1: 0102 SPEED for operating modes ABB 3-Wire, Baldor 2-Wire, Motor Potentiometer, Hand/Auto and Process control; 0103 OUTPUT FREQ for operating mode ABB 2-Wire Signal 2: 0104 CURRENT Signal 3: 0105 TORQUE. To change the default signals, select up to three signals from group OPERATING DATA to be shown. Signal 1: Change the value of parameter 3401 SIGNAL1 PARAM to the index of the signal parameter in group OPERATING DATA (= number of the parameter without the leading zero), e.g. 105 means parameter 0105 TORQUE. Value 100 means that no signal is displayed. Repeat for signals 2 (3408 SIGNAL2 PARAM) and 3 (3415 SIGNAL3 PARAM).	  
2	Select how you want the signals to be displayed: as a decimal number or a bar graph. For decimal numbers, you can specify the decimal point location, or use the decimal point location and unit of the source signal (setting 9 [DIRECT]). For details, see parameter 3404. Signal 1: parameter 3404 OUTPUT1 DSP FORM Signal 2: parameter 3411 OUTPUT2 DSP FORM Signal 3: parameter 3418 OUTPUT3 DSP FORM.	
3	Select the units to be displayed for the signals. This has no effect if parameter 3404/3411/3418 is set to 9 (DIRECT). For details, see parameter 3405. Signal 1: parameter 3405 OUTPUT1 UNIT Signal 2: parameter 3412 OUTPUT2 UNIT Signal 3: parameter 3419 OUTPUT3 UNIT.	
4	Select the scalings for the signals by specifying the minimum and maximum display values. This has no effect if parameter 3404/3411/3418 is set to 9 (DIRECT). For details, see parameters 3406 and 3407. Signal 1: parameters 3406 OUTPUT1 MIN and 3407 OUTPUT1 MAX Signal 2: parameters 3413 OUTPUT2 MIN and 3414 OUTPUT2 MAX Signal 3: parameters 3420 OUTPUT3 MIN and 3421 OUTPUT3 MAX.	 

6.2.7 Assistants Mode

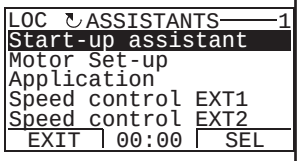
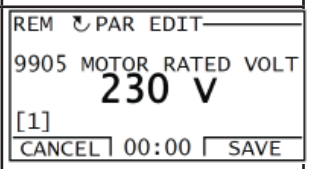
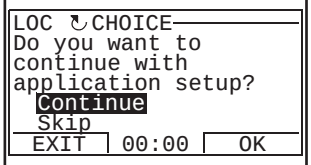
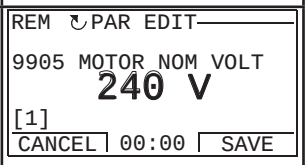
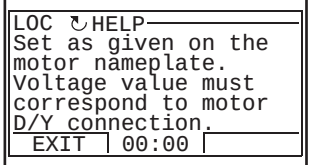
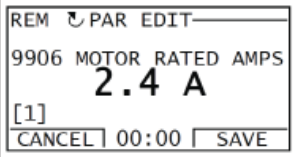
When the drive is first powered up, the Start-up assistant guides you through the setup of the basic parameters. The Start-up assistant is divided into assistants, each of which is responsible for the specification of a related parameter set, for example Motor set-up or PID control. The Start-up assistant activates the assistants one after the other. You may also use the assistants independently. For more information on the tasks of the assistants, see section Start-up assistant.

In the Assistants mode, you can:

- use assistants to guide you through the specification of a set of basic parameters.
- start, stop, change the direction and switch between local and remote control.

6.2.7.1 How to Use an Assistant

The table below shows the basic operation sequence which leads you through assistants. The Motor set-up assistant is used as an example.

Step	Action	Display
1	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing EXIT repeatedly until you get to the Main menu.	
2	Go to the Assistants mode by selecting ASSISTANTS on the menu keys ▲ and ▼, and pressing ENTER.	
3	Select the assistant with keys ▲ and ▼, and press SEL. If you select any other assistant than the Start-up assistant, it guides you through the task of specification of its parameter set as shown in steps 4 and 5 below. After that you can select another assistant on the Assistants menu or exit the Assistants mode. The Motor set-up assistant is used here as an example. If you select the Start-up assistant, it activates the first assistant, which guides you through the task of specification of its parameter set as shown in steps 4 and 5 below. The Start-up assistant then asks if you want to continue with the next assistant or skip it – select the appropriate answer with keys ▲ and ▼, and press SEL. If you choose to skip, the Start-up assistant asks the same question about the next assistant, and so on.	 
4	• To specify a new value, press keys ▲ and ▼. • To ask for information on the requested parameter, press key ? . Scroll the help text with keys ▲ and ▼. Close the help by pressing EXIT.	 
5	• To accept the new value and continue to the setting of the next parameter, press SAVE. • To stop the assistant, press EXIT.	

The table below lists the tasks of the assistants and the relevant drive parameters. Depending on the selection made in the Application task (parameter 9902 Operating Mode), the Start-up Assistant decides which consequent tasks it suggests.

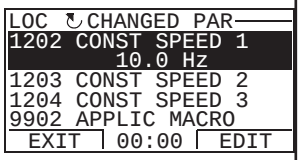
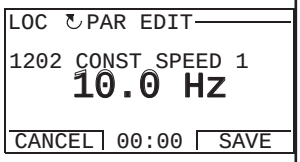
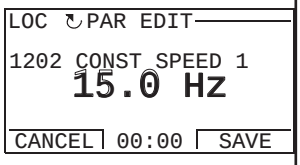
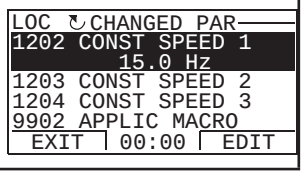
Name	Description	Set Parameters
Language Select	Selecting the language	9901
Motor Set-Up	Setting the motor data Performing the motor identification. (If the speed limits are not in the allowed range: Setting the limits.)	9904 - 9909 9910
Application	Selecting the operating mode	9902, parameters associated to the operating mode
Option Modules	Activating the option modules	Group: Motor Temp Meas Group: Panel Comm 9802
Speed Control EXT1	Selecting the source for the speed reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits Setting the speed frequency limits Setting the acceleration and deceleration times	1103 (1301 - 1303, 3001) 1104, 1105 2001, 2002, (2007, 2008) 2202, 2203
Speed Control EXT2	Selecting the source for the speed reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits	1106 (1301 - 1303, 3001) 1107, 1108
Process Control	Selecting the source for the process reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits Setting the speed (reference) limits Setting the source and limits for the process actual value	1106 (1301 - 1303, 3001 1107, 1108 2001, 2002, (2007, 2008) 4016, 4018, 4019
Start/ Stop Control	Selecting the source for start and stop signals of the two external control locations, EXT1 and EXT2 Selecting between EXT1 and EXT2 Defining the direction control Defining the start and stop modes Selecting the use of Run Enable signal Selecting timed function status indicated through relay output RO Selecting timed PID1 parameter set 1/2 control	1001, 1002 1102 1003 2101 - 2103 1601 1401 4027
Protections	Setting the current and torque limits	2003, 2017
Output Signals	Selecting the signals indicated through relay output RO Selecting the signals indicated through analog output AO Setting the minimum, maximum, scaling and inversion	Group: Relay Outputs Group: Analog Outputs

6.2.8 Changed Parameters Mode

In the Changed parameters mode, you can:

- view a list of all parameters that have been changed from the macro default values
- change these parameters
- start, stop, change the direction and switch between local and remote control.

6.2.8.1 How to View and Edit Changed Parameters

Step	Action	Display
1	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing EXIT repeatedly until you get to the Main menu.	
2	Go to the Changed parameters mode by selecting CHANGED PAR on the menu with keys ▲ and ▼, and pressing ENTER.	
3	Select the changed parameter on the list with keys ▲ and ▼. The value of the selected parameter is shown below it. Press EDIT to modify the value.	
4	Specify a new value for the parameter with keys ▲ and ▼. Pressing the key once increments or decrements the value. Holding the key down changes the value faster. Pressing the keys simultaneously replaces the displayed value with the default value.	
5	• To accept the new value, press SAVE. If the new value is the default value, the parameter is removed from the list of changed parameters. • To cancel the new value and keep the original, press CANCEL.	

6.2.9 Fault Logger Mode

In the Fault logger mode, you can:

- view the drive fault history of maximum ten faults (after a power off, only the three latest faults are kept in the memory)
- see the details of the three latest faults (after a power off, the details of only the most recent fault is kept in the memory)
- read the help text for the fault
- start, stop, change the direction and switch between local and remote control.

6.2.9.1 How to View Faults

Step	Action	Display
1	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing EXIT repeatedly until you get to the Main menu.	LOC ↻MAIN MENU 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT | 00:00 | ENTER
2	Go to the Fault logger mode by selecting FAULT LOGGER on the menu with keys ▲ and ▼, and pressing ENTER. The display shows the fault log starting with the latest fault. The number on the row is the fault code according to which the causes and corrective actions are listed in chapter Fault tracing.	LOC ↻FAULT LOGGER 10: PANEL LOSS 19.03.05 13:04:57 6: DC UNDERVOLT 6: AI1 LOSS EXIT | 00:00 | DETAIL
3	To see the details of a fault, select it with keys ▲ and ▼, and press DETAIL.	LOC ↻PANEL LOSS FAULT 10 FAULT TIME 1 13:04:57 FAULT TIME 2 EXIT | 00:00 | DIAG
4	To show the help text, press DIAG. Scroll the help text with keys ▲ and ▼. After reading the help, press OK to return to the previous display.	LOC ↻DIAGNOSTICS Check: Comm lines and connections, parameter 3002, parameters in groups 10 and 11. EXIT | 00:00 | OK

6.2.10 Time and Date Mode

In the Time and date mode, you can:

- show or hide the clock
- change date and time display formats
- set the date and time
- enable or disable automatic clock transitions according to the daylight saving changes
- start, stop, change the direction and switch between local and remote control.

The assistant keypad contains a battery to ensure the function of the clock when the panel is not powered by the drive.

6.2.10.1 How to Show or Hide the Clock, Change Display Formats, Set the Date and Time and Enable or Disable Clock Transitions due to Daylight Saving Changes.

Step	Action	Display
1	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing EXIT repeatedly until you get to the Main menu.	LOC ↻MAIN MENU———1 PARAMETERS ASSISTANTS CHANGED PAR EXIT | 00:00 | ENTER
2	Go to the Time and date mode by selecting TIME & DATE on the menu with keys ▲ and ▼, and pressing ENTER.	LOC ↻TIME & DATE——1 CLOCK VISIBILITY TIME FORMAT DATE FORMAT SET TIME SET DATE EXIT | 00:00 | SEL
3	• To show (hide) the clock, select CLOCK VISIBLILITY on the menu, press SEL, select Show clock (Hide clock) and press SEL, or, if you want to return to the previous display without making changes, press EXIT.	LOC ↻CLOCK VISIB——1 Show clock Hide clock EXIT | 00:00 | SEL
	• To specify the date format, select DATE FORMAT on the menu, press SEL and select a suitable format. Press OK to save or CANCEL to cancel your changes.	LOC ↻DATE FORMAT——1 dd.mm.yy mm/dd/yy dd.mm.yyyy mm/dd/yyyy CANCEL | 00:00 | OK
	• To specify the time format, select TIME FORMAT on the menu, press SEL and select a suitable format. Press to OK save or CANCEL to cancel your changes.	LOC ↻TIME FORMAT——1 24-hour 12-hour CANCEL | 00:00 | OK
	• To set the time, select SET TIME on the menu and press SEL. Specify the hours with keys ▲ and ▼, and press OK. Then specify the minutes. Press OK to save or CANCEL to cancel your changes.	LOC ↻SET TIME——— 15:41 CANCEL | 00:00 | OK
	• To set the date, select SET DATE on the menu and press SEL. Specify the first part of the date (day or month depending on the selected date format) with keys ▲ and ▼, and press OK. Repeat for the second part. After specifying the year, press OK. To cancel your changes, press CANCEL.	LOC ↻SET DATE——— 19.03.05 CANCEL | 00:00 | OK
	• To enable or disable the automatic clock transitions according to the daylight saving changes, select DAYLIGHT SAVING on the menu and press SEL. Pressing ? opens the help that shows the beginning and end dates of the period during which daylight saving time is used in each country or area whose daylight saving changes you can select to be followed. Scroll the help text with keys ▲ and ▼. • To disable automatic clock transitions according to the daylight saving changes, select Off and press SEL. • To enable automatic clock transitions, select the country or area whose daylight saving changes are followed and press SEL. • To return to the previous display without making changes, press EXIT.	LOC DAYLIGHT SAV—1 Off EU US Australia1:NSW,Vict.. Australia2:Tasmania.. EXIT | 00:00 | SEL LOC HELP——— EU: On: Mar last Sunday Off: Oct last Sunday US: EXIT | 00:00 |

6.2.11 Parameter Backup Mode

The Parameter backup mode is used to export parameters from one drive to another or to make a backup of the drive parameters. Uploading to the panel stores all drive parameters, including up to three user sets, to the assistant keypad. The full set, partial parameter set (application) and user sets can then be downloaded from the keypad to another drive or the same drive. Uploading and downloading can be performed in local control.

The keypad memory is non-volatile and does not depend on the panel battery.

In the Parameter backup mode, you can:

- Copy all parameters from the drive to the keypad (UPLOAD TO PANEL). This includes all defined user sets of parameters and internal (not adjustable by the user) parameters such as those created by the ID run.
- View the information about the backup stored to the keypad with UPLOAD TO PANEL (BACKUP INFO). This includes eg the type and rating of the drive where the backup was made. It is useful to check this information when you are going to copy the parameters to another drive with DOWNLOAD FULL SET to ensure that the drives match.
- Restore the full parameter set from the keypad to the drive (DOWNLOAD FULL SET). This writes all parameters, including the internal non-user-adjustable motor parameters, to the drive. It does not include the user sets of parameters.

Note: Only use this function to restore a drive from a backup or to transfer parameters to systems that are identical to the original system.

- Copy a partial parameter set (part of the full set) from the keypad to a drive (DOWNLOAD APPLICATION). The partial set does not include user sets, internal motor parameters, parameters 9905 - 9909, 1607, 5201, nor any group: EXT COMM MODULE and EFB PROTOCOL parameters. The source and target drives and their motor sizes do not need to be the same.
- Copy user set 1 parameters from the keypad to the drive (DOWNLOAD USER SET1). A user set includes group START-UP DATA parameters and the internal motor parameters. The function is only shown on the menu when user set 1 has been first saved using parameter 9902 OPERATING MODE (see section user Operating Modes) and then uploaded to the keypad with UPLOAD TO PANEL.
- Copy user set 2 parameters from the keypad to the drive (DOWNLOAD USER SET2). As DOWNLOAD USER SET1 above.
- Copy user set 3 parameters from the keypad to the drive (DOWNLOAD USER SET3). As DOWNLOAD USER SET1 above.
- Start, stop, change the direction and switch between local and remote control.

6.2.11.1 How to Upload and Download Parameters

For the upload and download functions available, see above. Note that the drive has to be in local control for uploading and downloading.

Step	Action	Display
1	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing EXIT repeatedly until you get to the Main menu. – If REM is shown on the status line, press first LOC/REM to switch to local control.	LOC ↻MAIN MENU 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT | 00:00 | ENTER
2	Go to the Par backup mode by selecting PAR BACKUP on the menu with keys ▲ and ▼, and pressing ENTER.	LOC ↻PAR BACKUP 1 UPLOAD TO PANEL BACKUP INFO DOWNLOAD FULL SET DOWNLOAD APPLICATION DOWNLOAD USER SET1 EXIT | 00:00 | SEL
3	• To copy all parameters (including user sets and internal parameters) from the drive to the keypad, select UPLOAD TO PANEL on the Par backup menu with keys ▼ and ▼, and press SEL . During the transfer, the display shows the transfer status as a percentage of completion. Press ABORT if you want to stop the operation. After the upload is completed, the display shows a message about the completion. Press OK to return to the Par backup menu.	LOC ↻PAR BACKUP Copying parameters 50% ABORT | 00:00 LOC ↻MESSAGE Parameter upload successful. OK | 00:00
	• To perform downloads, select the appropriate operation (here DOWNLOAD FULL SET is used as an example) on the Par backup menu with keys ▲ and ▼ , and press SEL. The display shows the transfer status as a percentage of completion. Press ABORT if you want to stop the operation. After the download is completed, the display shows a message about the completion. Press OK to return to the Par backup menu.	LOC ↻PAR BACKUP Downloading parameters (full set) 50% ABORT | 00:00 LOC ↻MESSAGE Parameter download successfully completed. OK | 00:00

6.2.11.2 How to View Information about the Backup

Set	Action	Display
1	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing EXIT repeatedly until you get to the Main menu.	LOC ↻MAIN MENU ———1 PARAMETERS ASSISTANTS CHANGED PAR EXIT | 00:00 | ENTER
2	Go to the Par backup mode by selecting PAR BACKUP on the menu with keys ▲ and ▼, and pressing ENTER.	LOC ↻PAR BACKUP ———1 UPLOAD TO PANEL BACKUP INFO DOWNLOAD FULL SET DOWNLOAD APPLICATION DOWNLOAD USER SET1 EXIT | 00:00 | SEL
3	Select BACKUP INFO on the Par backup menu with keys ▲ and ▼, and press SEL. The display shows the following information about the drive where the backup was made: DRIVE TYPE type of the drive DRIVE RATING: rating of the drive in format XXXYZ, where XXX: Nominal current rating. If present, an "A" indicates a decimal point, e.g. 4A6 means 4.6 A. Y: 2 = 200 V, 4 = 400 V, 6 = 600 V Z : i = European loading package, n = US loading package FIRMWARE: firmware version of the drive You can scroll the information with keys ▲ and ▼.	LOC ↻BACKUP INFO ——— DRIVE TYPE ACS550 3304 DRIVE RATING 4A62i 3301 FIRMWARE EXIT | 00:00 | LOC ↻BACKUP INFO ——— ACS550 3304 DRIVE RATING 4A62i 3301 FIRMWARE 300F hex EXIT | 00:00 |
4	Press EXIT to return to the Par backup menu.	LOC ↻PAR BACKUP ———1 UPLOAD TO PANEL BACKUP INFO DOWNLOAD FULL SET DOWNLOAD APPLICATION DOWNLOAD USER SET1 EXIT | 00:00 | SEL

6.2.12 I/O Settings Mode

In the I/O settings mode, you can:

- check the parameter settings related to any I/O terminal
- edit the parameter setting. For example, if “1103: REF1” is listed under Ain1 (Analog input 1), that is, parameter 1103 REF1 SELECT has value AI1, you can change its value to e.g. AI2. You cannot, however, set the value of parameter 1106 REF2 SELECT to AI1.
- start, stop, change the direction and switch between local and remote control.

6.2.12.1 How to Edit and Change Parameter Settings Related to I/O Terminals

Step	Action	Display
1	Go to the Main menu by pressing MENU if you are in the Output mode, otherwise by pressing EXIT repeatedly until you get to the Main menu.	LOC ↻MAIN MENU 1 PARAMETERS ASSISTANTS CHANGED PAR EXIT | 00:00 | ENTER
2	Go to the I/O settings mode by selecting I/O SETTINGS on the menu with keys ▲ and ▼, and pressing ENTER.	LOC ↻I/O SETTINGS 1 DIGITAL INPUTS (DI) ANALOG INPUTS (AI) RELAY OUTPUTS (ROUT) ANALOG OUTPUTS (AOUT) PANEL EXIT | 00:00 | SEL
3	Select the I/O group, e.g. DIGITAL INPUTS, with keys ▲ and ▼, and press SEL. After a brief pause, the display shows the current settings for the selection.	LOC ↻I/O SETTINGS –DI1– 1001:START/STOP (E1) –DI2– –DI3– EXIT | 00:00 |
4	Select the setting (line with a parameter number) with keys ▲ and ▼, and press EDIT.	LOC ↻PAR EDIT 1001 EXT1 COMMANDS DI1 [1] CANCEL | 00:00 | SAVE
5	Specify a new value for the setting with keys ▲ and ▼. Pressing the key once increments or decrements the value. Holding the key down changes the value faster. Pressing the keys simultaneously replaces the displayed value with the default value.	LOC ↻PAR EDIT 1001 EXT1 COMMANDS DI1,2 [2] CANCEL | 00:00 | SAVE
6	• To save the new value, press SAVE. • To cancel the new value and keep the original, press CANCEL.	LOC ↻I/O SETTINGS –DI1– 1001:START/STOP (E1) –DI2– 1001:DIR (E1) –DI3– EXIT | 00:00 |

Chapter 7
Parameter Descriptions

7.1 Parameters

Table 7-1 Parameter Definitions

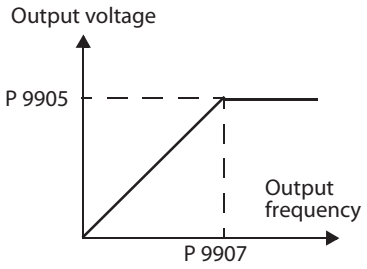
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
START-UP DATA	**LANGUAGE** (9901)	Default: 0 (English) Range: 0 - 2
	0	English
	1	Spanish
	2	French
		Selects the display language. There are two different Assistant Control Panels, each supporting a different language set.
	OPERATING MODE (9902)	Default: 1 Range: 1 - 6
	1	ABB 2-Wire
	2	ABB 3-Wire
	3	Baldor 2-Wire
	4	Motor Pot
	5	Hand/Auto
	6	PID Control
		Selects an application operating mode. Application macros automatically edit parameters to configure the ACB530 for a particular application. **NOTE:** OPERATING MODE (9902) can only be modified if the drive is stopped.
	CONTROL TYPE (9904)	Default: 2 Range: 1 - 2
	1	Open Vector – sensorless vector control mode. • Reference 1 is speed reference in rpm. • Reference 2 is speed reference in % (100% is absolute maximum speed, equal to the value of parameter 2002 MAXIMUM SPEED, or 2001 MINIMUM SPEED if the absolute value of the minimum speed is greater than the maximum speed).
	2	V/F Control – scalar control mode. • Reference 1 is frequency reference in Hz. • Reference 2 is frequency reference in % (100% is absolute maximum frequency, equal to the value of parameter 2008 MAXIMUM FREQ, or 2007 MINIMUM FREQ if the absolute value of the minimum speed is greater than the maximum speed).
		Selects the motor control mode. **NOTE:** CONTROL TYPE (9904) can only be modified if the drive is stopped.
	MOTOR RATED VOLTS (9905)	Default: -U1-yyyy-2:230V -U1-yyyy-4: 460 V -U1-yyyy-6: 575 V Range: -U1-yyyy-2: 115…345 V -U1-yyyy-4: 230…690 V -U1-yyyy-6: 288…862 V 
		Defines the nominal motor voltage. • Must equal the value on the motor rating plate. • The ACB530 cannot supply the motor with a voltage greater than the input power (mains) voltage. **NOTE:** MOTOR RATED VOLT (9905) can only be modified if the drive is stopped.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
START-UP DATA (Continued)	**MOTOR RATED AMPS** (9906)	Default: 1.0 · $/_{2hd}$ Range: 0.2 · $/_{2hd}$ - 2.0 · $/_{2hd}$ (where $/_{2hd}$ is drive current)
		Defines the nominal motor current. • Must equal the value on the motor rating plate. **NOTE:** MOTOR RATED AMPS (9906) can only be modified if the drive is stopped.
	MOTOR RATED FREQ (9907)	Default: -01: 50.0 Hz -U1: 60.0 Hz Range: 10.0 - 500.0 Hz (typically 50 or 60 Hz)
		Defines the nominal motor frequency. • Sets the frequency at which output voltage equals the MOTOR RATED FREQ. • Field weakening point = Nom Freq · Supply Volt / Mot Rated Freq **NOTE:** MOTOR RATED FREQ (9907) can only be modified if the drive is stopped.
	MOTOR RATED SPEED (9908)	Default: Dependent Upon Size Range: 50 - 30,000 RPM
		Defines the nominal motor speed. • Must equal the value on the motor rating plate. **NOTE:** MOTOR RATED RPM (9908) can only be modified if the drive is stopped.
	MOTOR RATED HP (9909)	Default: 1.0 · P_{hd} Range: 0.2· P_{hd} - 3.0 · P_{hd}
		Defines the nominal motor power. • Must equal the value on the motor rating plate. **NOTE:** MOTOR RATED HP (9909) can only be modified if the drive is stopped.
	CALC MOTOR MODEL (9910)	Default: 0 Range: 0 - 1
	0	NO – The CALC MOTOR MODEL process is not run. Identification magnetization is performed, depending on parameter 9904 and 2101 settings. In identification magnetization, the motor model is calculated at first start by magnetizing the motor for 10 to 15 s at zero speed (motor not rotating). The model is recalculated always at start after motor parameter changes. • Parameter 9904 = 1 (OPEN VECTOR): Identification magnetization is performed. • Parameter 9904 = 2 (V/F CONTROL) and parameter 2101 = 3 (SCALAR FLYST) or 5 (FLY + BOOST): Identification magnetization is performed. • Parameter 9904 = 2 (V/F CONTROL) and parameter 2101 has other value than 3 (SCALAR FLYST) or 5 (FLY + BOOST): Identification magnetization is not performed.
	1	YES – Enables the CALC MOTOR MODEL, during which the motor is rotating, at the next start command. After run completion, this value automatically changes to 0.
		This parameter controls a self-calibration process called the CALC MOTOR MODEL. During this process, the drive operates the motor (motor rotating) and makes measurements in order to identify motor characteristics and create a model used for internal calculations. A CALC MOTOR MODEL is especially effective when: • vector control mode is used [parameter 9904 = 1 (OPEN VECTOR) or 2 (V/F CONTROL], and/or - operation point is near zero speed, and/or - operation requires a torque range above the motor nominal torque, over a wide speed range, and without any measured speed feedback (i.e. without a pulse encoder). **NOTE:** The motor must be de-coupled from the driven equipment. **NOTE:** If motor parameters are changed after ID Run, repeat the CALC MOTOR MODEL. **WARNING! The motor will run at up to approximately 50-80% of the nominal speed during the CALC MOTOR MODEL. The motor will rotate in the forward direction. Ensure that it is safe to run the motor before performing the CALC MOTOR MODEL! See also section How to perform the CALC MOTOR MODEL.** **NOTE:** CALC MOTOR MODEL (9910) can only be modified if the drive is stopped.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
OPERATING DATA (Continued)	**MOTOR COSPHI** (9915)	Default: 0 Range: 0 - 0.97
	0	IDENTIFIED – Drive identifies the cos phi automatically by estimation.
	0.01 - 0.97	Value entered used as the cos phi.
		Defines the nominal motor cos phi (power factor). The parameter improves performance especially with high efficiency motors. **NOTE:** MOTOR COSPHI (9915) can only be modified if the drive is stopped.
	SPEED & DIR (0101)	**Read Only** Range: -30000 to 30000 RPM
		The calculated signed speed of the motor (rpm). The absolute value of 0101 SPEED & DIR is the same as the value of 0102 SPEED. • The value of 0101 SPEED & DIR is positive if the motor runs in the forward direction. • The value of 0101 SPEED & DIR is negative if the motor runs in the reverse direction.
	SPEED (0102)	**Read Only** Range: 0 to 30000 RPM
		The calculated speed of the motor (rpm). (Parameter 0102 or 0103 is shown by default in the control panel Output mode.)
	OUTPUT FREQ (0103)	**Read Only** Range: 0.0 - 500.0 Hz
		The frequency (Hz) applied to the motor. (Parameter 0102 or 0103 is shown by default in the control panel Output mode.)
	CURRENT (0104)	**Read Only** Range: 0.0 - 2.0 · $/_{2hd}$
		The motor current, as measured by the ACB530. (Shown by default in the control panel Output mode.)
	TORQUE (0105)	**Read Only** Range: -200.0 to 200.0%
		Output torque. Calculated value of torque on motor shaft in % of motor nominal torque. (Shown by default in the control panel Output mode.)
	POWER (0106)	**Read Only** Range: -2.0 · P_{hd} to 2.0 · P_{hd}
		The measured motor power in kW.
	DC BUS VOLTAGE (0107)	**Read Only** Range: 0 · V_{dN} to 2.5 · V_{dN}
		The DC bus voltage in V DC, as measured by the ACB530.
	OUTPUT VOLTAGE (0109)	Default: Range: 0 · V_{dN} to 2.0 · V_{dN}
		The voltage applied to the motor.
	DRIVE TEMP (0110)	**Read Only** Range: 0.0 - 150.0°C
		The temperature of the drive power transistors in degrees Celsius.
	EXTERNAL REF 1 (0111)	**Read Only** Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		External reference, REF1, in rpm or Hz – units determined by parameter 9904.
	EXTERNAL REF 2 (0112)	**Read Only** Range: 0.0 - 100.0% (0.0 - 600.0% for torque)
		External reference, REF2, in %.

Table 7-1 Parameter Definitions Continued

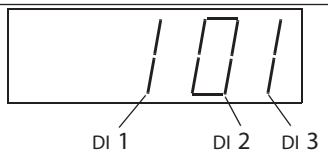
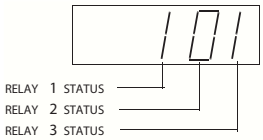
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
OPERATING DATA (Continued)	**CTRL LOCATION** (0113)	**Read Only** Range: 0 - 2
	0	LOCAL
	1	EXT1
	2	EXT2
		Active control location.
	RUN TIME (R) (0114)	**Read Only** Range: 0 - 9999 h
		The drive's accumulated running time in hours (h). • Can be reset by pressing UP and DOWN keys simultaneously when the control panel is in the Parameters mode.
	KWH COUNTER (0115)	**Read Only** Range: 0 - 65535 kWh
		The drive's accumulated power consumption in kilowatt hours. • The counter value is accumulated till it reaches 65535 after which the counter rolls over and starts again from 0. • Can be reset by pressing UP and DOWN keys simultaneously when the control panel is in the Parameters mode.
	APPL BLK OUTPUT (0116)	**Read Only** Range: 0.0 - 100.0% (0.0 - 600.0% for torque)
		Application block output signal. Value is from either: • PFC control, if PFC Control is active, or • Parameter 0112 EXTERNAL REF 2.
	DI 1-3 STATUS (0118)	**Read Only** Range: 000 - 111 (0 - 7 decimal)
		Status of the three digital inputs. • Status is displayed as a binary number. • 1 indicates that the input is activated. • 0 indicates that the input is deactivated. 
	DI 4-6 STATUS (0119)	**Read Only** Range: 000 - 111 (0 - 7 decimal)
		Status of the three digital inputs. • See parameter 0118 DI 1-3 STATUS.
	AI 1 (0120)	**Read Only** Range: 0.0 - 100.0%
		The relative value of analog input 1 in %.
	AI 2 (0121)	**Read Only** Range: 0.0 - 100.0%
		The relative value of analog input 2 in %.
	RO 1-3 STATUS (0122)	**Read Only** Range: 000 - 111 (0 - 7 decimal)
		Status of the three relay outputs. • 1 indicates that the relay is energized. • 0 indicates that the relay is de-energized. 
	AO 1 (0124)	**Read Only** Range: 0.0 - 20.0mA
		The analog output 1 value in milliamperes.
	AO 2 (0125)	**Read Only** Range: 0.0 - 20.0mA
		The analog output 2 value in milliamperes.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
OPERATING DATA (Continued)	**PID 1 OUTPUT** (0126)	**Read Only** Range: -1000.0 to 1000.0%
		The PID controller 1 output value in %.
	PID 1 SETPNT (0128)	**Read Only** Range: Unit and scale defined by par. 4006/4106 and 4007/4107
		The PID 1 controller setpoint signal. • Units and scale defined by PID parameters.
	PID 1 FBK (0130)	**Read Only** Range: Unit and scale defined by par. 4006/4106 and 4007/4107
		The PID 1 controller feedback signal. • Units and scale defined by PID parameters.
	PID 1 DEVIATION (0132)	**Read Only** Range: Unit and scale defined by par. 4006/4106 and 4007/4107
		The difference between the PID 1 controller reference value and actual value. • Units and scale defined by PID parameters.
	COMM RO WORD (0134)	**Read Only** Range: 0 - 65535
		Free data location that can be written from serial link. • Used for relay output control. • See parameter 1401.
	COMM VALUE 1 (0135)	**Read Only** Range: -32768 to +32767
		Free data location that can be written from serial link.
	COMM VAULE 2 (0136)	**Read Only** Range: -32768 to +32767
		Free data location that can be written from serial link.
	PROCESS VAR 1 (0137)	**Read Only** Range:
		Process variable 1 • Defined by parameters in Group: PANEL DISPLAY.
	PROCESS VAR 2 (0138)	**Read Only** Range:
		Process variable 2 • Defined by parameters in Group: PANEL DISPLAY.
	PROCESS VAR 3 (0139)	**Read Only** Range:
		Process variable 3 • Defined by parameters in Group: PANEL DISPLAY.
	RUN TIME (0140)	**Read Only** Range: 0.00 - 499.99 kh
		The drive's accumulated running time in thousands of hours (kh). • Cannot be reset.
	MWH COUNTER (0141)	**Read Only** Range: 0 - 65535 MWh
		The drive's accumulated power consumption in megawatt hours. • The counter value is accumulated till it reaches 65535 after which the counter rolls over and starts again from 0. • Cannot be reset.
	REVOLUTION CNTR (0142)	**Read Only** Range: 0 - 65535 Mrev
		The motor's accumulated revolutions in millions of revolutions. • Can be reset by pressing UP and DOWN keys simultaneously when the control panel is in the Parameters mode.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
OPERATING DATA (Continued)	**DRIVE ON TIME HI** (0143)	**Read Only** Range: 0 - 65535 days
		The drive's accumulated power-on time in days. • Cannot be reset.
	DRIVE ON TIME LO (0144)	**Read Only** Range: 00:00:00 - 23:59:58
		The drive's accumulated power-on time in 2 second ticks (30 ticks = 60 seconds). • Shown in format hh.mm.ss. • Cannot be reset.
	MOTOR TEMP (0145)	**Read Only** Range: Par. 3501 = 1 to 3: -10 to 200°C Par. 3501 = 4: 0 to 5000 ohm Par. 3501 = 5 to 6: 0 to 1
		Motor temperature in degrees Celsius / PTC resistance in ohms. • Applies only if motor temperature sensor is set up. • See parameter 3501.
	CB TEMP (0150)	**Read Only** Range: -20.0 to 150.0°C
		Temperature of the drive control board in degrees Celsius. **Note:** Some drives have a control board (OMIO) that does not support this feature. These drives always show the constant value of 25.0°C.
	MOT THERM STRESS (0153)	**Read Only** Range: 0.0 - 100.0%
		Estimated rise of the motor temperature. Value equals to the estimated motor thermal stress as a percentage of the motor temperature trip level.
	PID COMM VALUE 1 (0158)	**Read Only** Range: -32768 to +32767
		Data received from fieldbus for PID control PID1.
	PID COMM VALUE 2 (0159)	**Read Only** Range: -32768 to +32767
		Data received from fieldbus for PID control PID1.
	SAVED KWH (0174)	**Read Only** Range: 0.0 - 999.9 kWh
		Energy saved in kWh compared to the energy used when the pump is connected directly to the supply. **Note:** The values of saved energy parameters 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 CO2 are derived from subtracting the drive's energy econsumed from the direct-on-line (DOL) consumption calculated on the basis of parameter 4508 PUMP POWER. As such, the accuracy of the values is dependent on the accuracy of the power estimate entered in that parameter. • The counter value is accumulated till it reaches 999.9 after which the counter rolls over and starts again from 0.0. • Can be reset with parameter 4509 ENERGY RESET (resets all energy calculators at the same time). • See Group: ENERGY SAVING.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
OPERATING DATA (Continued)	**SAVED MWH** (0175)	**Read Only** Range: 0 - 65535 MWh
		Energy saved in MWh compared to the energy used when the pump is connected directly to the supply. **Note:** The values of saved energy parameters 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 CO2 are derived from subtracting the drive's energy econsumed from the direct-on-line (DOL) consumption calculated on the basis of parameter 4508 PUMP POWER. As such, the accuracy of the values is dependent on the accuracy of the power estimate entered in that parameter. • The counter value is accumulated till it reaches 65535 after which the counter rolls over and starts again from 0. • Can be reset with parameter 4509 ENERGY RESET (resets all energy calculators at the same time). • See Group: ENERGY SAVING.
	SAVED AMOUNT 1 (0176)	**Read Only** Range: 0.0 - 999.9
		Energy saved in local currency (remainder when the total saved energy is divided by 1000). **Note:** The values of saved energy parameters 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 CO2 are derived from subtracting the drive's energy econsumed from the direct-on-line (DOL) consumption calculated on the basis of parameter 4508 PUMP POWER. As such, the accuracy of the values is dependent on the accuracy of the power estimate entered in that parameter. • To find out the total saved energy in currency units, add the value of parameter 0177 multiplied by 1000 to the value of parameter 0176. Example: 0176 SAVED AMOUNT 1 = 123.4 0177 SAVED AMOUNT 2 = 5 Total saved energy = 5 · 1000 + 123.4 = 5123.4 currency units. • The counter value is accumulated till it reaches 999.9 (the counter does not roll over). • Can be reset with parameter 4509 ENERGY RESET (resets all energy calculators at the same time). • Local energy price is set with parameter 4502 ENERGY PRICE. • See Group: ENERGY SAVING.
	SAVED AMOUNT 2 (0177)	**Read Only** Range: 0 - 65535
		Energy saved in local currency in thousand currency units. Eg value 5 means 5000 currency units. **Note:** The values of saved energy parameters 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 CO2 are derived from subtracting the drive's energy econsumed from the direct-on-line (DOL) consumption calculated on the basis of parameter 4508 PUMP POWER. As such, the accuracy of the values is dependent on the accuracy of the power estimate entered in that parameter. • The counter value is accumulated till it reaches 65535 (the counter does not roll over). • See parameter 0176 SAVED AMOUNT 1.

Table 7-1 Parameter Definitions Continued

<table>
<tr><th>Group</th><th>Parameter (Number)
Selection (Value)</th><th>Parameter Name and Description</th></tr>
<tr><td rowspan="2">OPERATING DATA (Continued)</td><td>SAVED CO2 (0178)</td><td>Read Only
Range: 0.0 - 6553.5 tn

Reduction on carbon dioxide emissions in tn.
Note: The values of saved energy parameters 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 CO2 are derived from subtracting the drive's energy econsumed from the direct-on-line (DOL) consumption calculated on the basis of parameter 4508 PUMP POWER. As such, the accuracy of the values is dependent on the accuracy of the power estimate entered in that parameter.
• The counter value is accumulated till it reaches 6553.5 (the counter does not roll over).
• Can be reset with parameter 4509 ENERGY RESET (resets all energy calculators at the same time).
• CO2 conversion factor is set with parameter 4507 CO2 CONV FACTOR.
• See Group: ENERGY SAVING.</td></tr>
<tr><td rowspan="4">FB ACTUAL SIGNALS</td><td>FB CMD WORD 1 (0301)</td><td>Read Only
Range:

Read-only copy of the Fieldbus Command Word 1.
• The fieldbus command is the principal means for controlling the drive from a fieldbus controller. The command consists of two Command Words. Bit coded instructions in the Command Words switch the drive between states.
• To control the drive, using the Command Words, an external location (EXT1 or EXT2) must be active and set to COMM. (See parameters 1001 and 1002.)
• The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in Bit 15 displays as 8000.

<table><tr><th>Bit #</th><th>0301, FB CMD WORD 1</th><th>0302, FB CMD WORD 2</th></tr><tr><td>0</td><td>STOP</td><td>FBLOCAL_CTL</td></tr><tr><td>1</td><td>START</td><td>FBLOCAL_REF</td></tr><tr><td>2</td><td>REVERSE</td><td>START_DISABLE1</td></tr><tr><td>3</td><td>LOCAL</td><td>START_DISABLE2</td></tr><tr><td>4</td><td>RESET</td><td>Reserved</td></tr><tr><td>5</td><td>EXT2</td><td>Reserved</td></tr><tr><td>6</td><td>RUN_DISABLE</td><td>Reserved</td></tr><tr><td>7</td><td>STPMODE_R</td><td>Reserved</td></tr><tr><td>8</td><td>STPMODE_EM</td><td>Reserved</td></tr><tr><td>9</td><td>STPMODE_C</td><td>Reserved</td></tr><tr><td>10</td><td>RAMP_2</td><td>Reserved</td></tr><tr><td>11</td><td>RAMP_OUT_0</td><td>REF_CONST</td></tr><tr><td>12</td><td>RAMP_HOLD</td><td>REF_AVE</td></tr><tr><td>13</td><td>RAMP_IN_0</td><td>LINK_ON</td></tr><tr><td>14</td><td>RREQ_LOCALLOC</td><td>REQ_STARTINH</td></tr><tr><td>15</td><td>TORQLIM2</td><td>OFF_INTERLOCK</td></tr></table></td></tr>
<tr><td>FB CMD WORD 2 (0302)</td><td>Read Only
Range:

Read-only copy of the Fieldbus Command Word 2.
• See parameter 0301.</td></tr>
<tr><td>FB STS WORD 1 (0303)</td><td>Read Only
Range:

Read-only copy of the Status Word 1.
• The drive sends status information to the fieldbus controller. The status consists of two Status Words.
• The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in Bit 15 displays as 8000.

<table><tr><th>Bit #</th><th>0303, FB STS WORD 1</th><th>0304, FB STS WORD 2</th></tr><tr><td>0</td><td>READY</td><td>ALARM</td></tr><tr><td>1</td><td>ENABLED</td><td>NOTICE</td></tr><tr><td>2</td><td>STARTED</td><td>DIRLOCK</td></tr><tr><td>3</td><td>RUNNING</td><td>LOCALLOCK</td></tr><tr><td>4</td><td>ZERO_SPEED</td><td>CTL_MODE</td></tr><tr><td>5</td><td>ACCELERATE</td><td>Reserved</td></tr><tr><td>6</td><td>DECELERATE</td><td>Reserved</td></tr><tr><td>7</td><td>AT_SETPOINT</td><td>CPY_CTL</td></tr><tr><td>8</td><td>LIMIT</td><td>CPY_REF1</td></tr><tr><td>9</td><td>SUPERVISION</td><td>CPY_REF2</td></tr><tr><td>10</td><td>REV_REF</td><td>REQ_CTL</td></tr><tr><td>11</td><td>REV_ACT</td><td>REQ_REF1</td></tr><tr><td>12</td><td>PANEL_LOCAL</td><td>REQ_REF2</td></tr><tr><td>13</td><td>FIELDBUS_LOCAL</td><td>REQ_REF2EXT</td></tr><tr><td>14</td><td>EXT2_ACT</td><td>ACK_STARTINH</td></tr><tr><td>15</td><td>FAULT</td><td>ACK_OFF_ILCK</td></tr></table></td></tr>
<tr><td>FB STS WORD 2 (0304)</td><td>Read Only
Range:

Read-only copy of the Status Word 2.
• See parameter 0303.</td></tr>
</table>

Table 7-1 Parameter Definitions Continued

<table>
<tr><th>Group</th><th>Parameter (Number)
Selection (Value)</th><th>Parameter Name and Description</th></tr>
<tr><td rowspan="6">FB ACTUAL SIGNALS (Continued)</td><td>FAULT WORD 1 (0305)</td><td>Read Only
Range:

Read-only copy of the Fault Word 1.
• When a fault is active, the corresponding bit for the active fault is set in the Fault Words.
• Each fault has a dedicated bit allocated within Fault Words.
• See section Fault listing for a description of the faults.
• The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in Bit 15 displays as 8000.
<table>
<tr><th>Bit #</th><th>0305, FAULT WORD 1</th><th>0306, FAULT WORD 2</th><th>0307, FAULT WORD 3</th></tr>
<tr><td>0</td><td>OVERCURRENT</td><td>Obsolete</td><td>EFB 1</td></tr>
<tr><td>1</td><td>DC OVERVOLT</td><td>THERM FAIL</td><td>EFB 2</td></tr>
<tr><td>2</td><td>DEV OVERTEMP</td><td>OPEX LINK</td><td>EFB 3</td></tr>
<tr><td>3</td><td>SHORT CIRC</td><td>OPEX PWR</td><td>INCOMPATIBLE SW</td></tr>
<tr><td>4</td><td>Reserved</td><td>CURR MEAS</td><td>USER LOAD CURVE</td></tr>
<tr><td>5</td><td>DC UNDERVOLT</td><td>SUPPLY PHASE</td><td>Reserved</td></tr>
<tr><td>6</td><td>AI1 LOSS</td><td>ENCODER ERR</td><td>Reserved</td></tr>
<tr><td>7</td><td>AI2 LOSS</td><td>OVERSPEED</td><td>Reserved</td></tr>
<tr><td>8</td><td>MOT OVERTEMP</td><td>Reserved</td><td>Reserved</td></tr>
<tr><td>9</td><td>PANEL LOSS</td><td>DRIVE ID</td><td>Reserved</td></tr>
<tr><td>10</td><td>ID RUN FAIL</td><td>CONFIG FILE</td><td>System error</td></tr>
<tr><td>11</td><td>MOTOR STALL</td><td>SERIAL 1 ERR</td><td>System error</td></tr>
<tr><td>12</td><td>CB OVERTEMP</td><td>EFB CON FILE</td><td>System error</td></tr>
<tr><td>13</td><td>EXT FAULT 1</td><td>FORCE TRIP</td><td>System error</td></tr>
<tr><td>14</td><td>EXT FAULT 2</td><td>MOTOR PHASE</td><td>System error</td></tr>
<tr><td>15</td><td>EARTH FAULT</td><td>OUTP WIRING</td><td>Param. setting fault</td></tr>
</table></td></tr>
<tr><td>FAULT WORD 2 (0306)</td><td>Read Only
Range:

Read-only copy of the Fault Word 2.
• See parameter 0305.</td></tr>
<tr><td>FAULT WORD 3 (0307)</td><td>Read Only
Range:

Read-only copy of the Fault Word 3.
• See parameter 0305.</td></tr>
<tr><td>ALARM WORD 1 (0308)</td><td>Read Only
Range:

• When an alarm is active, the corresponding bit for the active alarm is set in the Alarm Words.
• Each alarm has a dedicated bit allocated within Alarm Words.
• Bits remain set until the whole alarm word is reset. (Reset by writing zero to the word.)
• The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displaysl as 0001. All zeros and a 1 in Bit 15 displays as 8000.
<table>
<tr><th>Bit #</th><th>0308, ALARM WORD 1</th><th>0309, ALARM WORD 2</th></tr>
<tr><td>0</td><td>OVERCURRENT</td><td>Reserved</td></tr>
<tr><td>1</td><td>OVERVOLTAGE</td><td>PID SLEEP</td></tr>
<tr><td>2</td><td>UNDERVOLTAGE</td><td>ID RUN</td></tr>
<tr><td>3</td><td>DIR LOCK</td><td>Reserved</td></tr>
<tr><td>4</td><td>IO COMM</td><td>START ENABLE 1 MISSING</td></tr>
<tr><td>5</td><td>AI1 LOSS</td><td>START ENABLE 2 MISSING</td></tr>
<tr><td>6</td><td>AI2 LOSS</td><td>EMERGENCY STOP</td></tr>
<tr><td>7</td><td>PANEL LOSS</td><td>ENCODER ERROR</td></tr>
<tr><td>8</td><td>DEVICE OVERTEMP</td><td>FIRST START</td></tr>
<tr><td>9</td><td>MOTOR TEMP</td><td>Reserved</td></tr>
<tr><td>10</td><td>Reserved</td><td>USER LOAD CURVE</td></tr>
<tr><td>11</td><td>MOTOR STALL</td><td>START DELAY</td></tr>
<tr><td>12</td><td>AUTORESET</td><td>Reserved</td></tr>
<tr><td>13</td><td>AUTOCHANGE</td><td>Reserved</td></tr>
<tr><td>14</td><td>PFC I LOCK</td><td>Reserved</td></tr>
<tr><td>15</td><td>Reserved</td><td>Reserved</td></tr>
</table></td></tr>
<tr><td>ALARM WORD 2 (0309)</td><td>Read Only
Range:

See parameter 0308.</td></tr>
</table>

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
FAULT HISTORY	**LAST FAULT** (0401)	**Read Only** Range: Fault codes (panel displays as text)
	0	Clear the fault history (on panel = NO RECORD).
	n	Fault code of the last recorded fault. The fault code is displayed as a name. See section Fault listing for the fault codes and names. The fault name shown for this parameter may be shorter than the corresponding name in the fault listing, which shows the names as they are shown in the fault display.
	FAULT TIME 1 (0402)	**Read Only** Range: Date dd.mm.yy / power-on time in days
		The day on which the last fault occurred. Either as: • A date – if real time clock is operating. • The number of days after power on – if real time clock is not used, or was not set.
	FAULT TIME 2 (0403)	**Read Only** Range: Time hh.mm.ss
		The time at which the last fault occurred. Either as: • Real time, in format hh:mm:ss – if real time clock is operating. • The time since power on (minus the whole days reported in 0402), in format hh:mm:ss – if real time clock is not used, or was not set. • Format on the Basic Control Panel: The time since power on in 2-second ticks (minus the whole days reported in 0402). 30 ticks = 60 seconds. E.g. Value 514 equals 17 minutes and 8 seconds (= 514/30).
	SPEED AT FLT (0404)	**Read Only** Range: -32768 to +32767
		The motor speed (rpm) at the time the last fault occurred.
	FREQ AT FLT (0405)	**Read Only** Range: -3276.8 to +3276.7
		The frequency (Hz) at the time the last fault occurred.
	VOLTAGE AT FLT (0406)	**Read Only** Range: 0.0 - 6553.5
		The DC bus voltage (V) at the time the last fault occurred.
	CURRENT AT FLT (0407)	**Read Only** Range: 0.0 - 6553.5
		The motor current (A) at the time the last fault occurred.
	TORQUE AT FLT (0408)	**Read Only** Range: -3276.8 to +3276.7
		The motor torque (%) at the time the last fault occurred.
	STATUS AT FLT (0409)	**Read Only** Range: 0000 - FFFF hex
		The drive status (hex code word) at the time the last fault occurred.
	DI 1-3 AT FLT (0410)	**Read Only** Range: 000 - 111 (0 - 7 decimal)
		The status of digital inputs 1…3 at the time the last fault occurred.
	DI 4-6 AT FLT (0411)	**Read Only** Range: 000 - 111 (0 - 7 decimal)
		The status of digital inputs 4…6 at the time the last fault occurred.
	PREVIOUS FAULT 1 (0412)	**Read Only** Range: As par. 0401
		Fault code of the second last fault. Read-only.
	PREVIOUS FAULT 2 (0413)	**Read Only** Range: As par. 0401
		Fault code of the third last fault. Read-only.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
START/STOP/ DIR	**EXT1 COMMANDS** (1001)	Default: 2 (DI1, 2) Range: 0 - 10
	0	NOT SEL – No external start, stop and direction command source.
	1	DI1 – Two-wire Start/Stop. • Start/Stop is through digital input DI1 (DI1 activated = Start; DI1 de-activated = Stop). • Parameter 1003 defines the direction. Selecting 1003 = 3 (REQUEST) is the same as 1003 = 1 (FORWARD).
	2	DI1, 2 – Two-wire Start/Stop, Direction. • Start/Stop is through digital input DI1 (DI1 activated = Start; DI1 de-activated = Stop). • Direction control [requires parameter 1003 = 3 (REQUEST)] is through digital input DI2 (DI2 activated = Reverse; de-activated = Forward).
	3	DI1P, 2P – Three-wire Start/Stop. • Start/Stop commands are through momentary push-buttons (the P stands for "pulse"). • Start is through a normally open push-button connected to digital input DI1. In order to start the drive, the digital input DI2 must be activated prior to the pulse in DI1. • Connect multiple Start push-buttons in parallel. • Stop is through a normally closed push-button connected to digital input DI2. • Connect multiple Stop push-buttons in series. • Parameter 1003 defines the direction. Selecting 1003 = 3 (REQUEST) is the same as 1003 = 1 (FORWARD).
	4	DI1P, 2P, 3 – Three-wire Start/Stop, Direction. • Start/Stop commands are through momentary push-buttons, as described for DI1P, 2P. • Direction control [requires parameter 1003 = 3 (REQUEST)] is through digital input DI3 (DI3 activated = Reverse; de-activated = Forward).
	5	DI1P, 2P, 3P – Start Forward, Start Reverse and Stop. • Start and Direction commands are given simultaneously with two separate momentary push-buttons (the P stands for "pulse"). • Start Forward command is through a normally open push-button connected to digital input DI1. In order to start the drive, the digital input DI3 must be activated prior to the pulse in DI1. • Start Reverse command is through a normally open push-button connected to digital input DI2. In order to start the drive, the digital input DI3 must be activated during the pulse in DI2. • Connect multiple Start push-buttons in parallel. • Stop is through a normally closed push-button connected to digital input DI3. • Connect multiple Stop push-buttons in series. • Requires parameter 1003 = 3 (REQUEST).
	6	DI6 – Two-wire Start/Stop. • Start/Stop is through digital input DI6 (DI6 activated = Start; DI6 de-activated = Stop). • Parameter 1003 defines the direction. Selecting 1003 = 3 (REQUEST) is the same as 1003 = 1 (FORWARD).
	7	DI6, 5 – Two-wire Start/Stop/Direction. • Start/Stop is through digital input DI6 (DI6 activated = Start; DI6 de-activated = Stop). • Direction control [requires parameter 1003 = 3 (REQUEST)] is through digital input DI5. (DI5 activated = Reverse; de-activated = Forward).
	8	KEYPAD – Control Panel. • Start/Stop and Direction commands are through the control panel when EXT1 is active. • Direction control requires parameter 1003 = 3 (REQUEST).

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
START/STOP/ DIR (Continued)	**EXT1 COMMANDS** (1001) (Continued)	Default: 2 (DI1, 2) Range: 0 - 10
	9	DI1F,2R – Start/Stop/Direction commands through DI1 and DI2 combinations. • Start forward = DI1 activated and DI2 de-activated. • Start reverse = DI1 de-activated and DI2 activated. • Stop = both DI1 and DI2 activated, or both de-activated. • Requires parameter 1003 = 3 (REQUEST).
	10	COMM – Assigns the fieldbus Command Word as the source for the start/stop and direction commands. • Bits 0,1, 2 of Command Word 1 (parameter 0301) activates the start/stop and direction commands. • See Fieldbus user's manual for detailed instructions.
		Defines external control location 1 (EXT1) – the configuration of start, stop and direction commands. **NOTE:** EXT1 COMMANDS (1001) can only be modified if the drive is stopped.
	EXT2 COMMANDS (1002)	Default: 0 (NOT SEL) Range: 0 - 14
		Defines external control location 2 (EXT2) – the configuration of start, stop and direction commands. • See parameter 1001 EXT1 COMMANDS above. **NOTE:** EXT2 COMMANDS (1002) can only be modified if the drive is stopped.
	DIRECTION (1003)	Default: 3 Range: 1 - 3
	1	FORWARD – Rotation is fixed in the forward direction.
	2	REVERSE – Rotation is fixed in the reverse direction.
	3	REQUEST – Rotation direction can be changed on command.
		Defines the control of motor rotation direction. **NOTE:** DIRECTION (1003) can only be modified if the drive is stopped.
	JOGGING SEL (1004)	Default: 0 (NOT SEL) Range: -6 to 6
	0	NOT SEL – Disables the jogging function.
	1	DI1 – Activates/de-activates jogging based on the state of DI1 (DI1 activated = jogging active; DI1 de-activated = jogging inactive).
	2 to 6	DI2 - DI6 – Activates jogging based on the state of the selected digital input. See DI1 above.
	-1	DI1 (INV) – Activates jogging based on the state of DI1 (DI1 activated = jogging inactive; DI1 de-activated = jogging active).
	-2 to -6	DI2 (INV) - DI6 (INV) – Activates jogging based on the state of the selected digital input. See DI1 (INV) above.
		Defines the signal that activates the jogging function. Jogging uses Constant Speed 7 (parameter 1208) for speed reference and ramp pair 2 (parameters 2205 and 2206) for accelerating and decelerating. When the jogging activation signal is lost, the drive uses ramp stop to decelerate to zero speed, even if coast stop is used in normal operation (parameter 2102). The jogging status can be parameterized to relay outputs (parameter 1401). The jogging status is also seen in DCU Profile status bit 21. **NOTE:** JOGGING SEL (1004) can only be modified if the drive is stopped.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
REFERENCE SELECT	**KEYPAD REF SEL** (1101)	Default: 1 Range: 1 - 2
	1	[REF1(Hz/rpm)] – Reference type depends on parameter 9904 CONTROL TYPE. • Speed reference (rpm) if 9904 = 1 (OPEN VECTOR). • Frequency reference (Hz) if 9904 = 2 (V/F CONTROL).
	2	REF2(%)
		Selects the reference controlled in local control mode.
	EXT1/EXT2 SEL (1102)	Default: 0 Range: -6 to 8,
	0	EXT1 – Selects external control location 1 (EXT1). • See parameter 1001 EXT1 COMMANDS for EXT1's Start/Stop/Dir definitions. • See parameter 1103 REF1 SELECT for EXT1's reference definitions.
	1	DI1 – Assigns control to EXT1 or EXT2 based on the state of DI1 (DI1 activated = EXT2; DI1 de-activated = EXT1).
	2 to 6	DI2 - DI6 – Assigns control to EXT1 or EXT2 based on the state of the selected digital input. See DI1 above.
	7	EXT2 – Selects external control location 2 (EXT2). • See parameter 1002 EXT2 COMMANDS for EXT2's Start/Stop/Dir definitions. • See parameter 1106 REF2 SELECT for EXT2's reference definitions.
	8	COMM – Assigns control of the drive via external control location EXT1 or EXT2 based on the fieldbus control word. • Bit 5 of the Command Word 1 (parameter 0301) defines the active external control location (EXT1 or EXT2). • See Fieldbus user's manual for detailed instructions.
	-1	DI1 (INV) – Assigns control to EXT1 or EXT2 based on the state of DI1 (DI1 activated = EXT1; DI1 de-activated = EXT2).
	-2 to -6	DI2 (INV) to DI6 (INV) – Assigns control to EXT1 or EXT2 based on the state of the selected digital input. See DI1 (INV) above.
		Defines the source for selecting between the two external control locations EXT1 or EXT2. Thus, defines the source for Start/Stop/Direction commands and reference signals. **NOTE:** EXT1/EXT2 SEL (1102) can only be modified if the drive is stopped.

Table 7-1 Parameter Definitions Continued

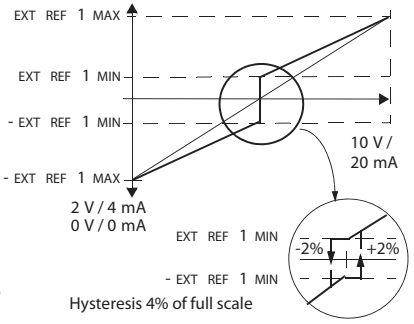
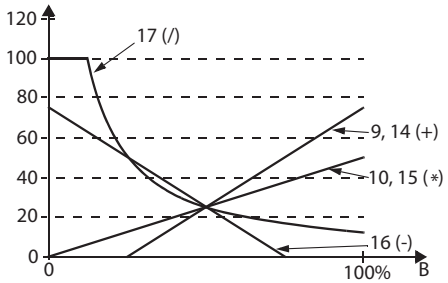
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
REFERENCE SELECT (Continued)	**REF1 SELECT** (1103)	Default: 1 Range: 0 - 17, 20 - 21
	0	KEYPAD – Defines the control panel as the reference source.
	1	AI1 – Defines analog input 1 (AI1) as the reference source.
	2	AI2 – Defines analog input 2 (AI2) as the reference source.
	3	AI1/JOYST – Defines analog input 1 (AI1), configured forjoystick operation, as the reference source. • The minimum input signal runs the drive at the maximum reference in the reverse direction. Define the minimum using parameter 1104. • The maximum input signal runs the drive at maximum reference in the forward direction. Define the maximum using parameter 1105. • Requires parameter 1003 = 3 (REQUEST).  **WARNING! Because the low end of the reference range commands full reverse operation, do not use 0 V as the lower end of the reference range. Doing so means that if the control signal is lost (which is a 0 V input) the result is full reverse operation. Instead, use the following set-up so that loss of the analog input triggers a fault, stopping the drive:** **• Set parameter 1301 MINIMUM AI1 (1304 MINIMUM AI2) at 20% (2V or 4mA).** **• Set parameter 3021 AI1 FAULT LIMIT to a value 5% or higher.** **• Set parameter 3001 AI<MIN FUNCTION to 1 (FAULT).**
	4	AI2/JOYST – Defines analog input 2 (AI2), configured for joystick operation, as the reference source. • See above (AI1/JOYST) description.
	5	DI3U, 4D(R) – Defines digital inputs as the speed reference source (motor potentiometer control). • Digital input DI3 increases the speed (the U stands for “up”). • Digital input DI4 decreases the speed (the D stands for “down”). • A Stop command resets the reference to zero (the R stands for “reset”). • Parameter 2205 ACCELER TIME 2 controls the reference signal’s rate of change.
	6	DI3U, 4D – Same as above (DI3U,4D(R)), except: • A Stop command does not reset the reference to zero. The reference is stored. • When the drive restarts, the motor ramps up (at the selected acceleration rate) to the stored reference.
	7	DI5U, 6D – Same as above (DI3U,4D), except that DI5 and DI6 are the digital inputs used.
	8	COMM – Defines the fieldbus as the reference source.
	9	COMM+AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog input reference correction below.
	10	COMM*AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog input reference correction below.
	11	DI3U, 4D(RNC) – Same as DI3U,4D(R) above, except that: • Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference.
	12	DI3U, 4D(NC) – Same as DI3U,4D above, except that: • Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference.
	13	DI5U, 6D(NC) – Same as DI5U,6D above, except that: • Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference.
	14	AI1+AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
REFERENCE SELECT (Continued)	**REF1 SELECT** (1103) (Continued)	Default: 1 Range: 0 - 17, 20 - 21
	15	AI1*AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below.
	16	AI1-AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below.
	17	AI1/AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below.
	20	KEYPAD(RNC) – Defines the control panel as the reference source. • A Stop command resets the reference to zero (the R stands for reset.). • Changing the control source (EXT1 to EXT2, EXT2 to EXT1) does not copy the reference.
	21	KEYPAD(NC) – Defines the control panel as the reference source. • A Stop command does not reset the reference to zero. The reference is stored. • Changing the control source (EXT1 to EXT2, EXT2 to EXT1) does not copy the reference.
		Selects the signal source for external reference REF1.
		Analog input reference correction Parameter values 9, 10 and 14 - 17 use the formula in the following table.

Value Setting	Calculation of the AI Reference
C + B	C value + (B value - 50% of reference value)
C * B	C value · (B value / 50% of reference value)
C - B	(C value + 50% of reference value) - B value
C / B	(C value · 50% of reference value) / B value

Where:
• C = Main reference value
(= COMM for values 9, 10 and
= AI1 for values 14 - 17).
• B = Correcting reference
(= AI1 for values 9, 10 and
= AI2 for values 14 - 17).
Example:
The figure shows the reference source curves for value settings 9, 10 and 14 - 17, where:
• C = 25%.
• P 4012 SETPOINT MIN = 0.
• P 4013 SETPOINT MAX = 0.
• B varies along the horizontal axis.



NOTE: REF1 SELECT (1103) can only be modified if the drive is stopped.

Table 7-1 Parameter Definitions Continued

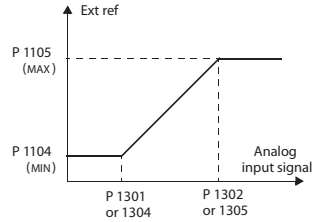
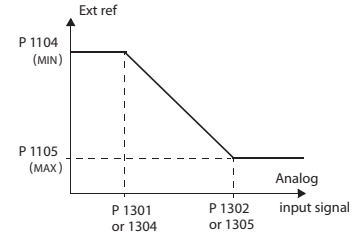
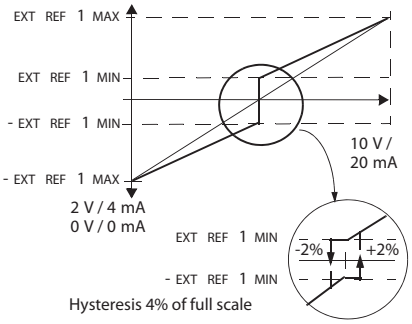
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
REFERENCE SELECT (Continued)	**REF1 MIN** (1104)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Sets the minimum for external reference 1. • The minimum analog input signal (as a percent of the full signal in volts or amperes) corresponds to REF1 MIN in Hz/rpm. • Parameter 1301 MINIMUM AI1 or 1304 MINIMUM AI2 sets the minimum analog input signal. • These parameters (reference and analog min. and max. settings) provide scale and offset adjustment for the reference.  
	REF1 MAX (1105)	Default: 60.0 (62.0) Hz / 1800 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Sets the maximum for external reference 1. • The maximum analog input signal (as a percent of full the signal in volts or amperes) corresponds to REF1 MAX in Hz/rpm. • Parameter 1302 MAXIMUM AI1 or 1305 MAXIMUM AI2 sets the maximum analog input signal.
	REF2 SELECT (1106)	Default: 2 Range: 0 - 17, 19 - 21
	0	KEYPAD – Defines the control panel as the reference source.
	1	AI1 – Defines analog input 1 (AI1) as the reference source.
	2	AI2 – Defines analog input 2 (AI2) as the reference source.
	3	AI1/JOYST – Defines analog input 1 (AI1), configured for joystick operation, as the reference source. • The minimum input signal runs the drive at the maximum reference in the reverse direction. Define the minimum using parameter 1104. • The maximum input signal runs the drive at maximum reference in the forward direction. Define the maximum using parameter 1105. • Requires parameter 1003 = 3 (REQUEST).  **WARNING! Because the low end of the reference range commands full reverse operation, do not use 0 V as the lower end of the reference range. Doing so means that if the control signal is lost (which is a 0 V input) the result is full reverse operation. Instead, use the following set-up so that loss of the analog input triggers a fault, stopping the drive:** **• Set parameter 1301 MINIMUM AI1 (1304 MINIMUM AI2) at 20% (2V or 4mA).** **• Set parameter 3021 AI1 FAULT LIMIT to a value 5% or higher.** **• Set parameter 3001 AI<MIN FUNCTION to 1 (FAULT).**
	4	AI2/JOYST – Defines analog input 2 (AI2), configured for joystick operation, as the reference source. • See above (AI1/JOYST) description.
	5	DI3U, 4D(R) – Defines digital inputs as the speed reference source (motor potentiometer control). • Digital input DI3 increases the speed (the U stands for “up”). • Digital input DI4 decreases the speed (the D stands for “down”). • A Stop command resets the reference to zero (the R stands for “reset”). • Parameter 2205 ACCELER TIME 2 controls the reference signal’s rate of change.

Table 7-1 Parameter Definitions Continued

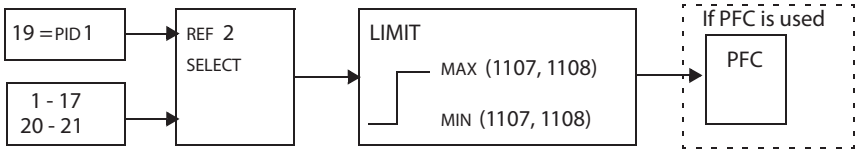
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
REFERENCE SELECT (Continued)	**REF2 SELECT** (1106) (Continued)	Default: 2 Range: 0 - 17, 19 - 21
	6	DI3U, 4D – Same as above (DI3U,4D(R)), except: • A Stop command does not reset the reference to zero. The reference is stored. • When the drive restarts, the motor ramps up (at the selected acceleration rate) to the stored reference.
	7	DI5U, 6D – Same as above (DI3U,4D), except that DI5 and DI6 are the digital inputs used.
	8	COMM – Defines the fieldbus as the reference source.
	9	COMM+AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog input reference correction below.
	10	COMM*AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog input reference correction below.
	11	DI3U, 4D(RNC) – Same as DI3U,4D(R) above, except that: • Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference.
	12	DI3U, 4D(NC) – Same as DI3U,4D above, except that: • Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference.
	13	DI5U, 6D(NC) – Same as DI5U,6D above, except that: • Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference.
	14	AI1+AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below.
	15	AI1*AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below.
	16	AI1-AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below.
	17	AI1/AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog input reference correction below.
	19	PID1OUT – The reference is taken from the PID1 output. See Group: PROCESS PID SET 1 and Group: PROCESS PID SET 2.
	20	KEYPAD(RNC) – Defines the control panel as the reference source. • A Stop command resets the reference to zero (the R stands for reset.). • Changing the control source (EXT1 to EXT2, EXT2 to EXT1) does not copy the reference.
	21	KEYPAD(NC) – Defines the control panel as the reference source. • A Stop command does not reset the reference to zero. The reference is stored. • Changing the control source (EXT1 to EXT2, EXT2 to EXT1) does not copy the reference.
		Selects the signal source for external reference REF2.  **NOTE:** REF2 SELECT (1106) can only be modified if the drive is stopped.

Table 7-1 Parameter Definitions Continued

<table>
<tr><th>Group</th><th>Parameter (Number)
Selection (Value)</th><th>Parameter Name and Description</th></tr>
<tr><td rowspan="4">REFERENCE SELECT (Continued)</td><td>REF2 MIN (1107)</td><td>Default: 0.0%
Range: 0.0 - 100.0% (0.0 - 600.0% for torque)</td></tr>
<tr><td></td><td>Sets the minimum for external reference 2.
• The minimum analog input signal (in volts or amperes) corresponds to REF2 MIN in %.
• Parameter 1301 MINIMUM AI1 or 1304 MINIMUM AI2 sets the minimum analog input signal.
• This parameter sets the minimum frequency reference.
• The value is a percentage of the:
– maximum frequency or speed
– maximum process reference
– nominal torque.</td></tr>
<tr><td>REF2 MAX (1108)</td><td>Default: 100.0%
Range: 0.0 - 100.0% (0.0 - 600.0% for torque)</td></tr>
<tr><td></td><td>Sets the maximum for external reference 2.
• The maximum analog input signal (in volts or amperes) corresponds to REF2 MAX in %.
• Parameter 1302 MAXIMUM AI1 or 1305 MAXIMUM AI2 sets the maximum analog input signal.
• This parameter sets the maximum frequency reference.
• The value is a percentage of the:
– maximum frequency or speed
– maximum process reference
– nominal torque.</td></tr>
<tr><td rowspan="8">CONSTANT SPEEDS</td><td>CONST SPEED SEL (1201)</td><td>Default: 9
Range -14 to 19</td></tr>
<tr><td>0</td><td>NOT SEL – Disables the constant speed function.</td></tr>
<tr><td>1</td><td>DI1 – Selects Constant Speed 1 with digital input DI1.
• Digital input activated = Constant Speed 1 activated.</td></tr>
<tr><td>2 - 6</td><td>DI2 - DI6 – Selects Constant Speed 1 with digital input DI2 - DI6. See above.</td></tr>
<tr><td>7</td><td>DI1, 2 – Selects one of three Constant Speeds (1 - 3) using DI1 and DI2.
• Uses two digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):
<table>
<tr><th>DI1</th><th>DI2</th><th>Function</th></tr>
<tr><td>0</td><td>0</td><td>No constant speed</td></tr>
<tr><td>1</td><td>0</td><td>Constant speed 1 (1202)</td></tr>
<tr><td>0</td><td>1</td><td>Constant speed 2 (1203)</td></tr>
<tr><td>1</td><td>1</td><td>Constant speed 3 (1204)</td></tr>
</table>
• Can be set up as a so-called fault speed, which is activated if the control signal is lost. Refer to parameter 3001 AI<MIN function and parameter 3002 PANEL COMM ERR.</td></tr>
<tr><td>8</td><td>DI2, 3 – Selects one of three Constant Speeds (1 - 3) using DI2 and DI3.
• See above (DI1, 2) for code.</td></tr>
<tr><td>9</td><td>DI3, 4 – Selects one of three Constant Speeds (1 - 3) using DI3 and DI4.
• See above (DI1, 2) for code.</td></tr>
<tr><td>10</td><td>DI4, 5 – Selects one of three Constant Speeds (1 - 3) using DI4 and DI5.
• See above (DI1, 2) for code.</td></tr>
<tr><td>11</td><td>DI5, 6 – Selects one of three Constant Speeds (1 - 3) using DI5 and DI6.
• See above (DI1, 2) for code.</td></tr>
</table>

Table 7-1 Parameter Definitions Continued

<table>
<tr><th>Group</th><th>Parameter (Number)
Selection (Value)</th><th>Parameter Name and Description</th></tr>
<tr><td>CONSTANT SPEEDS (Continued)</td><td>CONST SPEED SEL (1201) (Continued)</td><td>Default: 9
Range -14 to 19</td></tr>
<tr><td></td><td>12</td><td>DI1, 2, 3 – Selects one of seven Constant Speeds (1 - 7) using DI1, DI2 and DI3.
• Uses three digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):
<table>
<tr><th>DI1</th><th>DI2</th><th>D3</th><th>Function</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>No constant speed</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Constant speed 1 (1202)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Constant speed 2 (1203)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Constant speed 3 (1204)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Constant speed 4 (1205)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Constant speed 5 (1206)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Constant speed 6 (1207)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Constant speed 7 (1208)</td></tr>
</table></td></tr>
<tr><td></td><td>13</td><td>DI3, 4, 5 – Selects one of seven Constant Speeds (1 - 7) using DI3, DI4 and DI5.
• See above (DI1, 2, 3) for code.</td></tr>
<tr><td></td><td>14</td><td>DI4, 5, 6 – Selects one of seven Constant Speeds (1 - 7) using DI4, DI5 and DI6.
• See above (DI1, 2, 3) for code.</td></tr>
<tr><td></td><td>-1</td><td>DI1 (INV) – Selects Constant Speed 1 with digital input DI1.
• Inverse operation: Digital input de-activated = Constant Speed 1 activated.</td></tr>
<tr><td></td><td>-2 to -6</td><td>DI2 (INV) - DI6 (INV) – Selects Constant Speed 1 with digital input. See above.</td></tr>
<tr><td></td><td>-7</td><td>DI1, 2 (INV) – Selects one of three Constant Speeds (1 - 3) using DI1 and DI2.
• Inverse operation uses two digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):
<table>
<tr><th>DI1</th><th>DI2</th><th>Function</th></tr>
<tr><td>1</td><td>1</td><td>No constant speed</td></tr>
<tr><td>0</td><td>1</td><td>Constant speed 1 (1202)</td></tr>
<tr><td>1</td><td>0</td><td>Constant speed 2 (1203)</td></tr>
<tr><td>0</td><td>0</td><td>Constant speed 3 (1204)</td></tr>
</table></td></tr>
<tr><td></td><td>-8</td><td>DI2, 3 (INV) – Selects one of three Constant Speeds (1 - 3) using DI2 and DI3.
• See above (DI1, 2 (INV)) for code.</td></tr>
<tr><td></td><td>-9</td><td>DI3, 4 (INV) – Selects one of three Constant Speeds (1 - 3) using DI3 and DI4.
• See above (DI1, 2 (INV)) for code.</td></tr>
<tr><td></td><td>-10</td><td>DI4, 5 (INV) – Selects one of three Constant Speeds (1 - 3) using DI4 and DI5.
• See above (DI1, 2 (INV)) for code.</td></tr>
<tr><td></td><td>-11</td><td>DI5, 6 (INV) – Selects one of three Constant Speeds (1 - 3) using DI5 and DI6.
• See above (DI1, 2 (INV)) for code.</td></tr>
<tr><td></td><td>-12</td><td>DI1, 2, 3 (INV) – Selects one of seven Constant Speeds (1 - 7) using DI1, DI2 and DI3.
• Inverse operation uses three digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):
<table>
<tr><th>DI1</th><th>DI2</th><th>D3</th><th>Function</th></tr>
<tr><td>1</td><td>1</td><td>1</td><td>No constant speed</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Constant speed 1 (1202)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Constant speed 2 (1203)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Constant speed 3 (1204)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Constant speed 4 (1205)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Constant speed 5 (1206)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Constant speed 6 (1207)</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Constant speed 7 (1208)</td></tr>
</table></td></tr>
<tr><td></td><td>-13</td><td>DI3, 4, 5 (INV) – Selects one of seven Constant Speeds (1 - 7) using DI3, DI4 and DI5.
• See above (DI1, 2, 3 (INV)) for code.</td></tr>
</table>

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
CONSTANT SPEEDS (Continued)	**CONST SPEED SEL** (1201) (Continued)	Default: 9 Range -14 to 19
	-14	DI4, 5, 6 (INV) – Selects one of seven Constant Speeds (1 - 7) using DI4, DI5 and DI6. • See above (DI1, 2, 3 (INV)) for code.
		Defines the digital inputs used to select Constant Speeds. See general comments in introduction. **NOTE:** CONST SPEED SEL (1201) can only be modified if the drive is stopped.
	CONST SPEED 1 (1202)	Default: 6.0 Hz / 360 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Sets value for Constant Speed 1. • The range and units depend on parameter 9904 CONTROL TYPE. • Range: 0 - 30000 rpm when 9904 = 1 (OPEN VECTOR). • Range: 0 - 500 Hz when 9904 = 2 (V/F CONTROL).
	CONST SPEED 2 (1203)	Default: 12.0 Hz / 720 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Each sets a value for a Constant Speed. See CONST SPEED 1 above. Constant Speed 7 is used also as jogging speed. See parameter 1004 JOGGING SEL.
	CONST SPEED 3 (1204)	Default: 18.0 Hz / 1080 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Each sets a value for a Constant Speed. See CONST SPEED 1 above. Constant Speed 7 is used also as jogging speed. See parameter 1004 JOGGING SEL.
	CONST SPEED 4 (1205)	Default: 24.0 Hz / 1440 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Each sets a value for a Constant Speed. See CONST SPEED 1 above. Constant Speed 7 is used also as jogging speed. See parameter 1004 JOGGING SEL.
	CONST SPEED 5 (1206)	Default: 30.0 Hz / 1800 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Each sets a value for a Constant Speed. See CONST SPEED 1 above. Constant Speed 7 is used also as jogging speed. See parameter 1004 JOGGING SEL.
	CONST SPEED 6 (1207)	Default: 48.0 Hz / 2880 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Each sets a value for a Constant Speed. See CONST SPEED 1 above. Constant Speed 7 is used also as jogging speed. See parameter 1004 JOGGING SEL.
	CONST SPEED 7 (1208)	Default: 60.0 Hz / 3600 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Each sets a value for a Constant Speed. See CONST SPEED 1 above. Constant Speed 7 is used also as jogging speed. See parameter 1004 JOGGING SEL.
ANALOG INPUTS	**MINIMUM AI1** (1301)	Default: 0.0% Range: 0.0 - 100.0%
		Defines the minimum value of the analog input. • Define value as a percent of the full analog signal range. See example below. • The minimum analog input signal corresponds to 1104 REF1 MIN or 1107 REF2 MIN. • MINIMUM AI cannot be greater than MAXIMUM AI. • These parameters (reference and analog min. and max. settings) provide scale and offset adjustment for the reference. • See the figure at parameter 1104. Example: To set the minimum analog input value to 4 mA: • Configure the analog input for 0…20 mA current signal. • Calculate the minimum (4 mA) as a percent of full range (20 mA) = 4mA / 20mA · 100% = 20%

Table 7-1 Parameter Definitions Continued

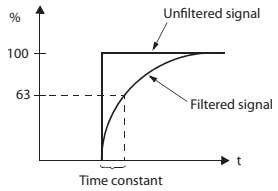
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
ANALOG INPUTS (Continued)	**MAXIMUM AI1** (1302)	Default: 100.0% Range: 0.0 - 100.0%
		Defines the maximum value of the analog input. • Define value as a percent of the full analog signal range. • The maximum analog input signal corresponds to 1105 REF1 MAX or 1108 REF2 MAX. • See the figure at parameter 1104.
	FILTER AI1 (1303)	Default: 0.1 s Range: 0.0 - 10.0 s
		Defines the filter time constant for analog input 1 (AI1). • The filtered signal reaches 63% of a step change within the time specified. 
	MINIMUM AI2 (1304)	Default: 0.0% Range: 0.0 - 100.0%
		Defines the minimum value of the analog input. • See MINIMUM AI1 above.
	MAXIMUM AI2 (1305)	Default: 100.0% Range: 0.0 - 100.0%
		Defines the maximum value of the analog input. • See MAXIMUM AI1 above.
	FILTER AI2 (1306)	Default: 0.1 s Range: 0.0 - 10.0 s
		Defines the filter time constant for analog input 2 (AI2). • See FILTER AI1 above.
RELAY OUTPUTS	**RELAY OUTPUT 1** (1401)	Default: 1 Range: 0 - 36, 46, 47, 52
	0	NOT SEL – Relay is not used and is de-energized.
	1	READY – Energize relay when drive is ready to function. Requires: • Run enable signal present. • No faults exist. • Supply voltage is within range. • Emergency Stop command is not on.
	2	RUN – Energize relay when the drive is running.
	3	FAULT(-1) – Energize relay when power is applied. De-energizes when a fault occurs.
	4	FAULT – Energize relay when a fault is active.
	5	ALARM – Energize relay when an alarm is active.
	6	REVERSED – Energize relay when motor rotates in reverse direction.
	7	STARTED – Energize relay when drive receives a start command (even if Run Enable signal is not present). De-energized relay when drive receives a stop command or a fault occurs.
	8	SUPRV1 OVER – Energize relay when first supervised parameter (3201) exceeds the limit (3203). • See Group: SUPERVISION.
	9	SUPRV1 UNDER – Energize relay when first supervised parameter (3201) drops below the limit (3202). • See Group: SUPERVISION.
	10	SUPRV2 OVER – Energize relay when second supervised parameter (3204) exceeds the limit (3206). • See Group: SUPERVISION.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
RELAY OUTPUTS (Continued)	**RELAY OUTPUT 1** (1401) (Continued)	Default: 1 Range: 0 - 36, 46, 47, 52
	11	SUPRV2 UNDER – Energize relay when second supervised parameter (3204) drops below the limit (3205). • See Group: SUPERVISION.
	12	SUPRV3 OVER – Energize relay when third supervised parameter (3207) exceeds the limit (3209). • See Group: SUPERVISION.
	13	SUPRV3 UNDER – Energize relay when third supervised parameter (3207) drops below the limit (3208). • See Group: SUPERVISION.
	14	AT SET POINT – Energize relay when the output frequency is equal to the reference frequency.
	15	FAULT(RST) – Energize relay when the drive is in a fault condition and will reset after the programmed auto-reset delay. • See parameter 3103 DELAY TIME.
	16	FLT/ALARM – Energize relay when fault or alarm occurs.
	17	EXT CTRL – Energize relay when external control is selected.
	18	REF 2 SEL – Energize relay when EXT2 is selected.
	19	CONST FREQ – Energize relay when a constant speed is selected.
	20	REF LOSS – Energize relay when reference or active control place is lost.
	21	OVERCURRENT – Energize relay when an overcurrent alarm or fault occurs.
	22	OVERVOLTAGE – Energize relay when an overvoltage alarm or fault occurs.
	23	DRIVE TEMP – Energize relay when a drive or control board overtemperature alarm or fault occurs.
	24	UNDERVOLTAGE – Energize relay when an undervoltage alarm or fault occurs.
	25	AI1 LOSS – Energize relay when AI1 signal is lost.
	26	AI2 LOSS – Energize relay when AI2 signal is lost.
	27	MOTOR TEMP – Energize relay when a motor overtemperature alarm or fault occurs.
	28	STALL – Energize relay when a stall alarm or fault exists.
	30	PID SLEEP – Energize relay when the PID sleep function is active.
	33	FLUX READY – Energize relay when the motor is magnetized and able to supply nominal torque (motor has reached nominal magnetizing).
	35	COMM – Energize relay based on input from fieldbus communication. • Fieldbus writes binary code in parameter 0134 that can energize relay 1 - relay 6 according to the following:

Par. 0134	Binary	RO6	RO5	RO4	RO3	RO2	RO1
0	000000	0	0	0	0	0	0
1	000001	0	0	0	0	0	1
2	000010	0	0	0	0	1	0
3	000011	0	0	0	0	1	1
4	000100	0	0	0	1	0	0
5 - 62	…	…	…	…	…	…	…
63	111111	1	1	1	1	1	1

• 0 = De-energize relay, 1 = Energize relay.

Table 7-1 Parameter Definitions Continued

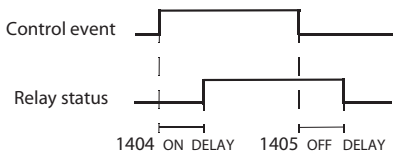
<table>
<tr><th>Group</th><th>Parameter (Number)
Selection (Value)</th><th>Parameter Name and Description</th></tr>
<tr><td rowspan="11">RELAY OUTPUTS (Continued)</td><td rowspan="11">RELAY OUTPUT 1 (1401) (Continued)</td><td>Default: 1
Range: 0 - 36, 46, 47, 52</td></tr>
<tr><td>COMM(-1) – Energize relay based on input from fieldbus communication.
• Fieldbus writes binary code in parameter 0134 that can energize relay 1 - relay 6 according to the following:
<table>
<tr><th>Par. 0134</th><th>Binary</th><th>RO6</th><th>RO5</th><th>RO4</th><th>RO3</th><th>RO2</th><th>RO1</th></tr>
<tr><td>0</td><td>000000</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>000001</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>2</td><td>000010</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>3</td><td>000011</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>4</td><td>000100</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>5 - 62</td><td>…</td><td>…</td><td>…</td><td>…</td><td>…</td><td>…</td><td>…</td></tr>
<tr><td>63</td><td>111111</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
• 0 = De-energize relay, 1 = Energize relay.</td></tr>
<tr><td>46 START DELAY – Energize relay when a start delay is active.</td></tr>
<tr><td>47 USER LOAD C – Energize relay when a user load curve fault or alarm occurs.</td></tr>
<tr><td>52 JOG ACTIVE – Energize relay when the jogging function is active.</td></tr>
<tr><td>Defines the event or condition that activates relay 1 – what relay output 1 means.</td></tr>
<tr><td>RELAY OUTPUT 2 (1402)</td><td>Default: 2
Range: 0 - 36, 46, 47, 52</td></tr>
<tr><td>Defines the event or condition that activates relay 2 – what relay output 2 means.
• See 1401 RELAY OUTPUT 1.</td></tr>
<tr><td>RELAY OUTPUT 3 (1403)</td><td>Default: 3
Range: 0 - 36, 46, 47, 52</td></tr>
<tr><td>Defines the event or condition that activates relay 3 – what relay output 3 means.
• See 1401 RELAY OUTPUT 1.</td></tr>
<tr><td>RO 1 ON DELAY (1404)</td><td>Default: 0.0 s
Range: 0.0 - 3600.0 s</td></tr>
<tr><td>Defines the switch-on delay for relay 1.
• On / off delays are ignored when relay output 1401 is set to PFC.
 
</td></tr>
<tr><td>RO 1 OFF DELAY (1405)</td><td>Default: 0.0 s
Range: 0.0 - 3600.0 s</td></tr>
<tr><td>Defines the switch-off delay for relay 1.
• On / off delays are ignored when relay output 1401 is set to PFC.</td></tr>
<tr><td>RO 2 ON DELAY (1406)</td><td>Default: 0.0 s
Range: 0.0 - 3600.0 s</td></tr>
<tr><td>Defines the switch-on delay for relay 2.
• See RO 1 ON DELAY.</td></tr>
<tr><td>RO 2 OFF DELAY (1407)</td><td>Default: 0.0 s
Range: 0.0 - 3600.0 s</td></tr>
<tr><td>Defines the switch-off delay for relay 2.
• See RO 1 OFF DELAY.</td></tr>
<tr><td>RO 3 ON DELAY (1408)</td><td>Default: 0.0 s
Range: 0.0 - 3600.0 s</td></tr>
<tr><td>Defines the switch-on delay for relay 3.
• See RO 1 ON DELAY.</td></tr>
</table>

Table 7-1 Parameter Definitions Continued

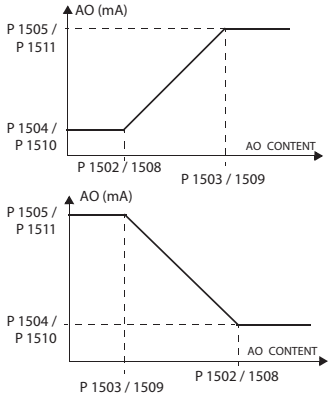
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
RELAY OUTPUTS (Continued)	**RO 3 OFF DELAY** (1409)	Default: 0.0 s Range: 0.0 - 3600.0 s
		Switch-off delay for relay 3. • See RO 1 OFF DELAY.
ANALOG OUTPUTS	**AO1 CONTENT SEL** (1501)	Default: 103 (Parameter 0103 OUPUT FREQ) Range: 99 - 178
	99	EXCITE PTC – Provides a current source for sensor type PTC. Output = 1.6mA. See Group: MOTOR TEMP MEAS.
	100	EXCITE PT100 – Provides a current source for sensor type PT100. Output = 9.1mA. See Group: MOTOR TEMP MEAS.
	101 - 178	Output corresponds to a parameter in Group: OPERATING DATA. • Parameter defined by value (value 102 = parameter 0102)
		Defines the content for analog output AO1.
	AO1 CONTENT MIN (1502)	Default: Depends on the signal selected with Parameter 1501. Range:
		Sets the minimum content value. • Content is the parameter selected by parameter 1501. • Minimum value refers to the minimum content value that will be converted to an analog output. • These parameters (content and current min. and max. settings) provide scale and offset adjustment for the output. See the figure. 
	AO1 CONTENT MAX (1503)	Default: Depends on the signal selected with Parameter 1501. Range: -
		Sets the maximum content value • Content is the parameter selected by parameter 1501. • Maximum value refers to the maximum content value that will be converted to an analog output.
	MINIMUM AO1 (1504)	Default: 0.0mA Range: 0.0 - 20.0mA
		Sets the minimum output current.
	MAXIMUM AO1 (1505)	Default: 20.0mA Range: 0.0 - 20.0mA
		Sets the maximum output current.
	FILTER AO1 (1506)	Default: 0.0 s Range: 0.0 - 10.0 s
		Defines the filter time constant for AO1. • The filtered signal reaches 63% of a step change within the time specified. • See the figure in parameter 1303.
	AO2 CONTENT SEL (1507)	Default: 104 (Parameter 0104 CURRENT) Range: 99 - 178
		Defines the content for analog output AO2. See AO1 CONTENT SEL above.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
ANALOG OUTPUTS (Continued)	**AO2 CONTENT MIN** (1508)	Default: Depends on the signal selected with Parameter 1507. Range: -
		Sets the minimum content value. See AO1 CONTENT MIN above.
	AO2 CONTENT MAX (1509)	Default: Depends on the signal selected with Parameter 1507. Range: -
		Sets the maximum content value. See AO1 CONTENT MAX above.
	MINIMUM AO2 (1510)	Default: 0.0mA Range: 0.0 - 20.0mA
		Sets the maximum content value. See AO1 CONTENT MAX above.
	MAXIMUM AO2 (1511)	Default: 20.0mA Range: 0.0 - 20.0mA
		Sets the maximum output current. See MAXIMUM AO1 above.
	FILTER AO2 (1512)	Default: 0.1 s Range: 0.0 - 10.0 s
		Defines the filter time constant for AO2. See FILTER AO1 above.
SYSTEM CONTROLS	**RUN ENABLE** (1601)	Default: 0 (NOT SEL) Range: -6 to 7
	0	NOT SEL – Allows the drive to start without an external run enable signal.
	1	DI1 – Defines digital input DI1 as the run enable signal. • This digital input must be activated for run enable. • If the voltage drops and de-activates this digital input, the drive will coast to stop and not start until the run enable signal resumes.
	2 to 6	DI2 - DI6 – Defines digital input DI2 - DI6 as the run enable signal. • See DI1 above.
	7	COMM – Assigns the fieldbus Command Word as the source for the run enable signal. • Bit 6 of the Command Word 1 (parameter 0301) activates the run disable signal. • See fieldbus user's manual for detailed instructions.
	-1	DI1 (INV) – Defines an inverted digital input DI1 as the run enable signal. • This digital input must be de-activated for run enable. • If this digital input activates, the drive will coast to stop and not start until the run enable signal resumes.
	-2 to -6	DI2 (INV) - DI6 (INV) – Defines an inverted digital input DI2 - DI6 as the run enable signal. • See DI1 (INV) above.
		Selects the source of the run enable signal. **NOTE:** RUN ENABLE (1601) can only be modified if the drive is stopped.
	PARAMETER LOCK (1602)	Default: 1 (OPEN) Range: 0 - 2
	0	LOCKED – You cannot use the control panel to change parameter values. • The lock can be opened by entering the valid pass code to parameter 1603.
	1	OPEN – You can use the control panel to change parameter values.
	2	NOT SAVED – You can use the control panel to change parameter values, but they are not stored in permanent memory. • Set parameter 1607 PARAM SAVE to 1 (SAVE) to store changed parameter values to memory.
		Determines if the control panel can change parameter values. • This lock does not limit parameter changes made by macros. • This lock does not limit parameter changes written by fieldbus inputs. • This parameter value can be changed only if the correct pass code is entered. See parameter 1603 PASS CODE.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
SYSTEM CONTROLS (Continued)	**PASS CODE** (1603)	Default: 0 Range: 0 - 65535
		Entering the correct pass code allows you to change the parameter lock. • See parameter 1602 above. • The code 358 allows you to change the value of the parameter 1602 once. • This entry reverts back to 0 automatically.
	FAULT RESET SEL (1604)	Default: 0 (KEYPAD) Range: -6 to 8
	0	KEYPAD – Defines the control panel as the only fault reset source. • Fault reset is always possible with control panel.
	1	DI1 – Defines digital input DI1 as a fault reset source. • Activating the digital input resets the drive.
	2 to 6	DI2 - DI6 – Defines digital input DI2 - DI6 as a fault reset source. • See DI1 above.
	7	START/STOP – Defines the Stop command as a fault reset source. • Do not use this option when fieldbus communication provides the start, stop and direction commands.
	8	COMM – Defines the fieldbus as a fault reset source. • The Command Word is supplied through fieldbus communication. • The bit 4 of the Command Word 1 (parameter 0301) resets the drive.
	-1	DI1 (INV) – Defines an inverted digital input DI1 as a fault reset source. • De-activating the digital input resets the drive.
	-2 to -6	DI2 (INV) - DI6 (INV) – Defines an inverted digital input DI2 - DI6 as a fault reset source. • See DI1 (INV) above.
		Selects the source for the fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists.
	LOCAL LOCK (1606)	Default: 0 (NOT SEL) Range: -6 to 7
	0	NOT SEL – Disables the lock. The control panel can select LOC and control the drive.
	1	DI1 – Defines digital input DI1 as the control for setting the local lock. • Activating the digital input locks out local control. • De-activating the digital input enable the LOC selection.
	2 to 6	DI2 - DI6 – Defines digital input DI2 - DI6 as the control for setting the local lock. • See DI1 above.
	7	ON – Sets the lock. The control panel cannot select LOC and cannot control the drive.
	8	COMM – Defines bit 14 of the Command Word 1 as the control for setting the local lock. • The Command Word is supplied through fieldbus communication. • The Command Word is 0301.
	-1	DI1 (INV) – Defines an inverted digital input DI1 as the control for setting the local lock. • De-activating the digital input locks out local control. • Activating the digital input enable the LOC selection.
	-2 to -6	DI2 (INV) - DI6 (INV) – Defines an inverted digital input DI2 - DI6 as the control for setting the local lock. • See DI1(INV) above.
		Defines control for the use of the LOC mode. The LOC mode allows drive control from the control panel. • When LOCAL LOCK is active, the control panel cannot change to LOC mode.

Table 7-1 Parameter Definitions Continued

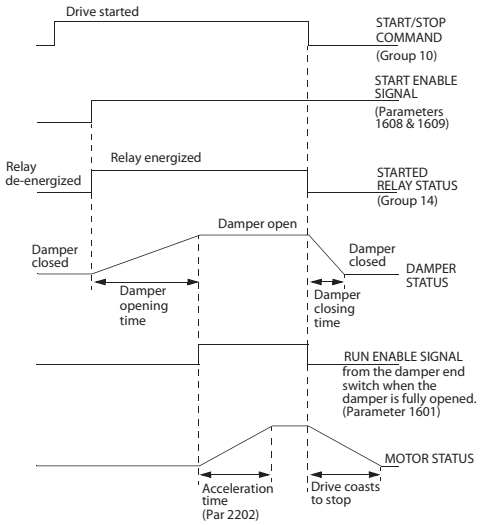
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
SYSTEM CONTROLS (Continued)	**PARAM SAVE** (1607)	Default: 0 (DONE) Range: 0 - 1
	0	DONE – Value changes automatically when all parameters are saved.
	1	SAVE… – Saves altered parameters to permanent memory.
		Saves all altered parameters to permanent memory. • Parameters altered through a fieldbus are not automatically saved to permanent memory. To save, you must use this parameter. • If 1602 PARAMETER LOCK = 2 (NOT SAVED), parameters altered from the control panel are not saved. To save, you must use this parameter. • If 1602 PARAMETER LOCK = 1 (OPEN), parameters altered from the control panel are stored immediately to permanent memory.
	START ENABLE 1 (1608)	Default: 0 (NOT SEL) Range: -6 to 7
	0	Selects the source of the start enable 1 signal. Note: Start enable functionality differs from the run enable functionality.
	1	SDI1 – Defines digital input DI1 as the start enable 1 signal. • This digital input must be activated for start enable 1 signal. • If the voltage drops and de-activates this digital input, the drive will coast to stop and show alarm 2021 on the panel display. The drive will not start until start enable 1 signal resumes.
	2 to 6	DI2 - DI6 – Defines digital input DI2 - DI6 as the start enable 1 signal. • See DI1 above.
	7	COMM – Assigns the fieldbus Command Word as the source for the start enable 1 signal. • Bit 2 of the Command word 2 (parameter 0302) activates the start disable 1 signal. • See fieldbus user's manual for detailed instructions.
	-1	DI1 (INV) – Defines an inverted digital input DI1 as the start enable 1 signal.
	-2 to -6	DI2 (INV) - DI6 (INV) – Defines an inverted digital input DI2 - DI6 as the start enable 1 signal. • See DI1 (INV) above.
		Selects the source of the start enable 1 signal. **Note:** Start enable functionality differs from the run enable functionality.  **NOTE:** START ENABLE 1 (1608) can only be modified if the drive is stopped.

Table 7-1 Parameter Definitions Continued

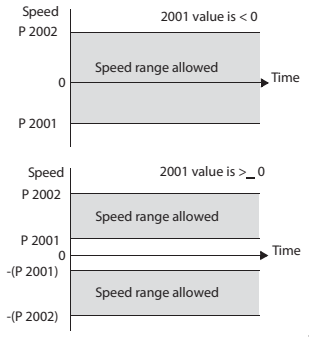
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
SYSTEM CONTROLS (Continued)	**START ENABLE 2** (1609)	Default: 0 (NOT SEL) Range: -6 to 7
	0	NOT SEL – Allows the drive to start without an external start enable signal.
	1	DI1 – Defines digital input DI1 as the start enable 2 signal. • This digital input must be activated for start enable 2 signal. • If the voltage drops and de-activates this digital input, the drive will coast to stop and show alarm 2022 on the panel display. The drive will not start until start enable 2 signal resumes.
	2 to 6	DI2 - DI6 – Defines digital input DI2 - DI6 as the start enable 2 signal. • See DI1 above.
	7	COMM – Assigns the fieldbus Command Word as the source for the start enable 2 signal. Bit 3 of the Command word 2 (parameter 0302) activates the start disable 2 signal. • See fieldbus user's manual for detailed instructions.
	-1	DI1 (INV) – Defines an inverted digital input DI1 as the start enable 2 signal.
	-2 to -6	DI2 (INV) - DI6 (INV) – Defines an inverted digital input DI2 - DI6 as the start enable 2 signal. • See DI1 (INV) above.
		Selects the source of the start enable 2 signal. Note: Start enable functionality differs from the run enable functionality. **NOTE:** START ENABLE 2 (1609) can only be modified if the drive is stopped.
	DISPLAY ALARMS (1610)	Default: 0 (NO) Range: 0 - 1
	0	NO – The above alarms are suppressed.
	1	YES – All of the above alarms are enabled.
		Controls the visibility of the following alarms: • 2001, Overcurrent alarm • 2002, Overvoltage alarm • 2003, Undervoltage alarm • 2009, Device overtemperature alarm. For more information, see section Alarm listing.
LIMITS	**MINIMUM SPEED** (2001)	Default: 0 RPM Range: -30000 to 30000 RPM
		Defines the minimum speed (rpm) allowed. • A positive (or zero) minimum speed value defines two ranges, one positive and one negative. • A negative minimum speed value defines one speed range. • See the figure. **NOTE:** MINIMUM SPEED (2001) can only be modified if the drive is stopped. 
	MAXIMUM SPEED (2002)	Default: -01: 1500 RPM/ -U1: 1800 RPM Range: 0 to 30000 RPM
		Defines the maximum speed (rpm) allowed. **NOTE:** MAXIMUM SPEED (2002) can only be modified if the drive is stopped.
	MAX CURRENT (2003)	Default: $1.8 \cdot I_{2hd}$ Range: $0 - 1.8 \cdot I_{2hd}$
		Defines the maximum output current (A) supplied by the drive to the motor. **NOTE:** MAX CURRENT (2003) can only be modified if the drive is stopped.

Table 7-1 Parameter Definitions Continued

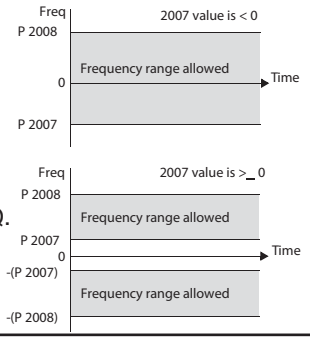
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
LIMITS (Continued)	**OVERVOLT CTRL** (2005)	Default: 1 (ENABLE) Range: 0 - 1
	0	DISABLE – Disables controller.
	1	ENABLE – Enables controller. **Note:** If a braking chopper or a braking resistor is connected to the drive, this parameter value must be set to 0 (DISABLE) to ensure proper operation of the chopper.
		Sets the DC overvoltage controller on or off. • Fast braking of a high inertia load causes the DC bus voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the trip limit, the overvoltage controller automatically decreases the braking torque by increasing output frequency.
	UNDERVOLT CTRL (2006)	Default: 1 [ENABLE (TIME)] Range: 0 - 2
	0	DISABLE – Disables controller.
	1	ENABLE (TIME) – Enables controller with 500 ms time limit for operation.
	2	ENABLE – Enables controller without maximum time limit for operation.
		Sets the DC undervoltage controller on or off. When on: • If the DC bus voltage drops due to loss of input power, the undervoltage controller decreases the motor speed in order to keep the DC bus voltage above the lower limit. • When the motor speed decreases, the inertia of the load causes regeneration back into the drive, keeping the DC bus charged and preventing an undervoltage trip. • The DC undervoltage controller increases power loss ride-through on systems with a high inertia, such as a centrifuge or a fan.
	MINIMUM FREQ (2007)	Default: 0.0 Hz Range: -500.0 to 500.0 Hz
		Defines the minimum limit for the drive output frequency. • A positive or zero minimum frequency value defines two ranges, one positive and one negative. • A negative minimum frequency value defines one speed range. See the figure. **NOTE:** Keep MINIMUM FREQ ≤ MAXIMUM FREQ. **NOTE:** MINIMUM FREQ (2007) can only be modified if the drive is stopped. 
	MAXIMUM FREQ (2008)	Default: 60.0 (62.0) Hz Range: 0.0 to 500.0 Hz
		Defines the maximum limit for the drive output frequency. **NOTE:** MAXIMUM FREQ (2008) can only be modified if the drive is stopped.
	MIN TORQUE 1 (2015)	Default: -300.0% Range: -600.0 to 0.0%
		Sets the first minimum limit for torque (%). Value is a percent of the motor nominal torque.
	MAX TORQUE 1 (2017)	Default: 300.0% Range: 0.0 to 600.0
		Sets the first maximum limit for torque (%). Value is a percent of the motor nominal torque.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
START/STOP	**START FUNCTION** (2101)	Default: 8 (RAMP) Range: 0.0 to 600.0
	1	AUTO – Selects the automatic start mode. • Vector control modes: Optimal start in most cases. The drive automatically selects the correct output frequency to start a rotating motor. • V/F CONTROL mode: Immediate start from zero frequency. Identical to selection 8 = RAMP.
	2	DC MAGN – Selects the DC Magnetizing start mode. **Note:** The DC Magnetizing start mode cannot start a rotating motor. **Note:** The drive starts when the set pre-magnetizing time (parameter 2103 DC MAGN TIME) has passed, even if motor magnetization is not complete. • Vector control modes: Magnetizes the motor within the time determined by the parameter 2103 DC MAGN TIME using DC current. The normal control is released exactly after the magnetizing time. This selection guarantees the highest possible break-away torque. • V/F CONTROL mode: Magnetizes the motor within the time determined by the parameter 2103 DC MAGN TIME using DC current. The normal control is released exactly after the magnetizing time.
	3	SCALAR FLYST – Selects the flying start mode. • Vector control modes: Not applicable. • V/F CONTROL mode: The drive automatically selects the correct output frequency to start a rotating motor – useful if the motor is already rotating and if the drive will start smoothly at the current frequency. • Cannot be used in multimotor systems.
	4	TORQ BOOST – Selects the automatic torque boost mode (V/F CONTROL mode only). • May be necessary in drives with high starting torque. • Torque boost is only applied at start, ending when output frequency exceeds 20 Hz or when output frequency is equal to reference. • In the beginning the motor magnetizes within the time determined by the parameter 2103 DC MAGN TIME using DC current. • See parameter 2110 TORQ BOOST CURR.
	5	FLY + BOOST – Selects both the flying start and the torque boost mode (V/F CONTROL mode only). • Flying start routine is performed first and the motor is magnetized. If the speed is found to be zero, the torque boost is done.
	8	RAMP – Immediate start from zero frequency.
		Selects the motor start method. The valid options depend on the value of parameter 9904 CONTROL TYPE. **NOTE:** START FUNCTION (2101) can only be modified if the drive is stopped.
	STOP FUNCTION (2102)	Default: 1 (COAST) Range: 1 - 2
	1	COAST – Selects cutting off the motor power as the stop method. The motor coasts to stop.
	2	RAMP – Selects using a deceleration ramp. • Deceleration ramp is defined by 2203 DECELER TIME 1 or 2206 DECELER TIME 2 (whichever is active).
		Selects the motor stop method.
	DC MAGN TIME (2103)	Default: 0.30 s Range: 0.00 - 10.00 s
		Defines the pre-magnetizing time for the DC Magnetizing start mode. • Use parameter 2101 to select the start mode. • After the start command, the drive pre-magnetizes the motor for the time defined here and then starts the motor. • Set the pre-magnetizing time just long enough to allow full motor magnetization. Too long a time heats the motor excessively.

Table 7-1 Parameter Definitions Continued

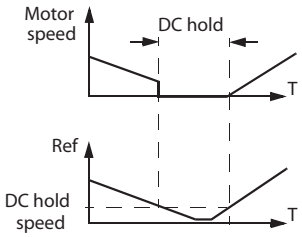
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
START/STOP (Continued)	**DC HOLD CTL** (2104)	Default: 0 (NOT SEL) Range: 0 - 2
	0	NOT SEL – Disables the DC current operation.
	1	DC HOLD – Enables the DC Hold function. See the diagram. • Requires parameter 9904 CONTROL TYPE = 1 (OPEN VECTOR) • Stops generating sinusoidal current and injects DC into the motor when both the reference and the motor speed drop below the value of parameter 2105. • When the reference rises above the level of parameter 2105 the drive resumes normal operation. 
	2	DC BRAKING – Enables the DC Injection Braking after modulation has stopped. • If parameter 2102 STOP FUNCTION is 1 (COAST), braking is applied after start is removed. • If parameter 2102 STOP FUNCTION is 2 (RAMP), braking is applied after ramp.
		Selects whether DC current is used for braking or DC Hold. **NOTE:** DC HOLD CTL (2104) can only be modified if the drive is stopped.
	DC HOLD SPEED (2105)	Default: 5 RPM Range: 0 - 360 RPM
		Sets the speed for DC Hold. Requires that parameter 2104 DC HOLD CTL = 1 (DC HOLD).
	DC CURR REF (2106)	Default: 30% Range: 0 - 100%
		Defines the DC current control reference as a percentage of parameter 9906 MOTOR NOM CURR.
	DC BRAKE TIME (2107)	Default: 0.0 s Range: 0.0 - 250.0 s
		Defines the DC brake time after modulation has stopped, if parameter 2104 is 2 (DC BRAKING).
	START INHIBIT (2108)	Default: 0 (OFF) Range: 0 - 1
	0	OFF – Disables the Start inhibit function.
	1	ON – Enables the Start inhibit function.
		Sets the Start inhibit function on or off. If the drive is not actively started and running, the Start inhibit function ignores a pending start command in any of the following situations and a new start command is required: • A fault is reset. • Run Enable (parameter 1601) activates while start command is active. • Mode changes from local to remote. • Control switches from EXT1 to EXT2. • Control switches from EXT2 to EXT1.

Table 7-1 Parameter Definitions Continued

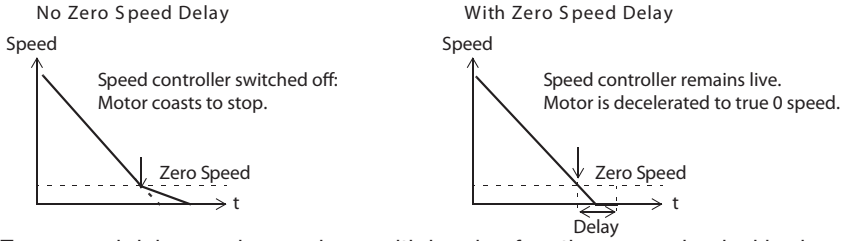
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
START/STOP (Continued)	**EMERG STOP SEL** (2109)	Default: 0 (NOT SEL) Range: -6 to 6
	0	NOT SEL – Disables the Emergency stop function through digital inputs.
	1	DI1 – Defines digital input DI1 as the control for Emergency stop command. • Activating the digital input issues an Emergency stop command. • De-activating the digital input removes the Emergency stop command.
	2 to 6	DI2 - DI6 – Defines digital input DI2 - DI6 as the control for Emergency stop command. • See DI1 above.
	-1	DI1 (INV) – Defines an inverted digital input DI1 as the control for Emergency stop command. • De-activating the digital input issues an Emergency stop command. • Activating the digital input removes the Emergency stop command.
	-2 to -6	DI2 (INV) - DI6 (INV) – Defines an inverted digital input DI2 - DI6 as the control for Emergency stop command. • See DI1 (INV) above.
		Defines control of the Emergency stop command. When activated: • Emergency stop decelerates the motor using the emergency stop ramp (parameter 2208 EMERG DEC TIME). • Requires an external stop command and removal of the emergency stop command before drive can restart.
	TORQ BOOST CURR (2110)	Default: 100% Range: 15 - 300%
		Sets the maximum supplied current during torque boost. • See parameter 2101 START FUNCTION.
	ZERO SPEED DELAY (2112)	Default: 0.0 s (NOT SEL) Range: 0.0 s, 0.1 s - 60.0 s
		Defines the delay for the Zero Speed Delay function. If parameter value is set to zero, the Zero Speed Delay function is disabled. The function is useful in applications where a smooth and quick restarting is essential. During the delay the drive knows accurately the rotor position.  Zero speed delay can be used e.g. with jogging function or mechanical brake. **No Zero Speed Delay** The drive receives a stop command and decelerates along a ramp. When the motor actual speed falls below an internal limit (called Zero Speed), the speed controller is switched off. The drive modulation is stopped and the motor coasts to standstill. **With Zero Speed Delay** The drive receives a stop command and decelerates along a ramp. When the motor actual speed falls below an internal limit (called Zero Speed), the zero speed delay function activates. During the delay the functions keeps the speed controller live: The drive modulates, motor is magnetized and drive is ready for a quick restart. **Note:** Parameter 2102 STOP FUNCTION must be 2 = RAMP for zero speed delay to operate. 0.0 = NOT SEL – Disables the Zero Speed Delay function.
	START DELAY (2113)	Default: 0.00 s Range: 0.00 s - 60.00 s
		Defines the Start delay. After the conditions for start have been fulfilled, the drive waits until the delay has elapsed and then starts the motor. Start delay can be used with all start modes. • If START DELAY = zero, the delay is disabled. • During the Start delay, alarm 2028 START DELAY is shown.

Table 7-1 Parameter Definitions Continued

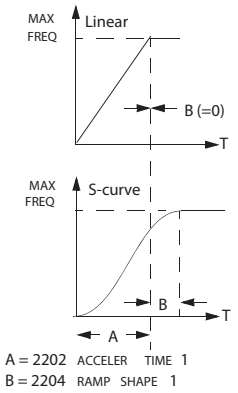
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
ACCEL/DECEL	**ACC/DEC 1/2 SEL** (2201)	Default: 5 (DI5) Range: -6 to 7
	0	NOT SEL – Disables selection, the first ramp pair is used.
	1	DI1 – Defines digital input DI1 as the control for ramp pair selection. • Activating the digital input selects ramp pair 2. • De-activating the digital input selects ramp pair 1.
	2	DI2 - DI6 – Defines digital input DI2 - DI6 as the control for ramp pair selection. • See DI1 above.
	7	COMM – Defines bit 10 of the Command Word 1 as the control for ramp pair selection. • The Command Word is supplied through fieldbus communication. • The Command Word is parameter 0301.
	-1	DI1 (INV) – Defines an inverted digital input DI1 as the control for ramp pair selection. • De-activating the digital input selects ramp pair 2 • Activating the digital input selects ramp pair 1.
	-2 to -6	DI2 (INV) - DI6 (INV) – Defines an inverted digital input DI2 - DI6 as the control for ramp pair selection. • See DI1 (INV) above.
		Defines control for selection of acceleration/deceleration ramps. • Ramps are defined in pairs, one each for acceleration and deceleration. • See below for the ramp definition parameters.
	ACCELER TIME 1 (2202)	Default: 5.0 s Range: 0.0 - 1800.0 s
		Sets the acceleration time for zero to maximum frequency for ramp pair 1. See A in the figure. • Actual acceleration time also depends on 2204 RAMP SHAPE 1. • See 2008 MAXIMUM FREQ. 
	DECELER TIME 1 (2203)	Default: 5.0 s Range: 0.0 - 1800.0 s
		Sets the deceleration time for maximum frequency to zero for ramp pair 1. • Actual deceleration time also depends on 2204 RAMP SHAPE 1. • See 2008 MAXIMUM FREQ.
	RAMP SHAPE 1 (2204)	Default: 0.0 s Range: 0.0 = LINEAR, 0.1 to 1000.0 s
		Selects the shape of the acceleration/deceleration ramp for ramp pair 1. See B in the figure. • Shape is defined as a ramp, unless additional time is specified here to reach the maximum frequency. A longer time provides a softer transition at each end of the slope. The shape becomes an s-curve. • Rule of thumb: 1/5 is a suitable relation between the ramp shape time and the acceleration ramp time. 0.0 = LINEAR – Specifies linear acceleration/deceleration ramps for ramp pair 1. 0.1 - 1000.0 = S-CURVE – Specifies s-curve acceleration/deceleration ramps for ramp pair 1.

Table 7-1 Parameter Definitions Continued

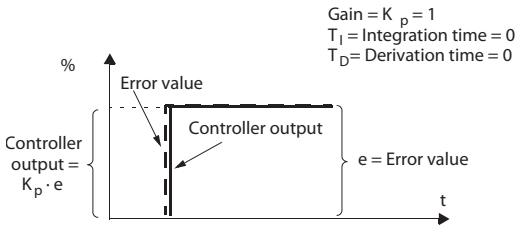
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
ACCEL/DECEL (Continued)	**ACCELER TIME 2** (2205)	Default: 60.0 s Range: 0.0 - 1800.0 s
		Sets the acceleration time for zero to maximum frequency for ramp pair 2. • See 2202 ACCELER TIME 1. • Used also as jogging acceleration time. See 1004 JOGGING SEL.
	DECELER TIME 2 (2206)	Default: 60.0 s Range: 0.0 - 1800.0 s
		Sets the deceleration time for maximum frequency to zero for ramp pair 2. • See 2203 DECELER TIME 1. • Used also as jogging deceleration time. See 1004 JOGGING SEL.
	RAMP SHAPE 2 (2207)	Default: 0.0 s Range: 0.0 = LINEAR, 0.1 to 1000.0 s
		Selects the shape of the acceleration/deceleration ramp for ramp pair 2. • See 2204 RAMP SHAPE 1.
	EMERG DEC TIME (2208)	Default: 1.0 s Range: 0.0 - 1800.0 s
		Sets the deceleration time for maximum frequency to zero for an emergency. • See parameter 2109 EMERG STOP SEL. • Ramp is linear.
	RAMP INPUT 0 (2209)	Default: 0 (NOT SEL) Range: -6 to 7
	0	NOT SEL – Not selected.
	1	DI1 – Defines digital input DI1 as the control for forcing the speed to 0. • Activating the digital input forces the speed to zero, after which the speed will stay at 0. • De-activating the digital input: speed control resumes normal operation.
	2 to 6	DI2 - DI6 – Defines digital input DI2 - DI6 as the control for forcing the speed to 0. • See DI1 above.
	7	COMM – Defines bit 13 of the Command Word 1 as the control for forcing the speed to 0. • The Command Word is supplied through fieldbus communication. • The Command Word is parameter 0301.
	-1	DI1 (INV) – Defines inverted digital input DI1 as the control for forcing the speed to 0. • De-activating the digital input forces the speed to 0. • Activating the digital input: speed control resumes normal operation.
	-2 to -6	DI2 (INV) - DI6 (INV) – Defines an inverted digital input DI2 - DI6 as the control for forcing the speed to 0. • See DI1 (INV) above.
		Defines control for forcing the speed to 0 with the currently used deceleration ramp (see parameters 2203 DECELER TIME 1 and 2206 DECELER TIME 2).
SPEED CONTROL	**PROP GAIN** (2301)	Default: 5.00 Range: 0.00 - 200.00
		Sets the relative gain for the speed controller. • Larger values may cause speed oscillation. • The figure shows the speed controller output after an error step (error remains constant). Note: You can use parameter 2305 AUTOTUNE RUN to automatically set the proportional gain. 

Table 7-1 Parameter Definitions Continued

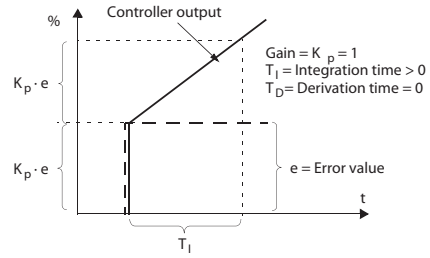
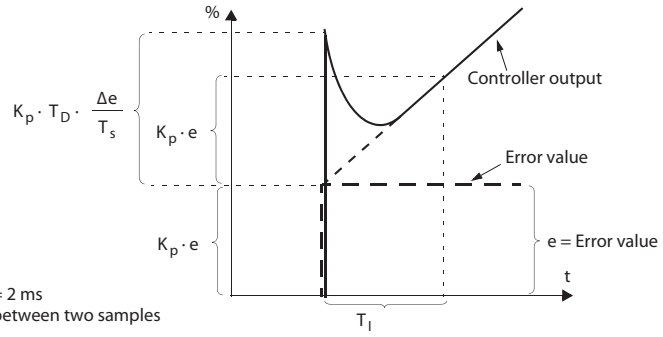
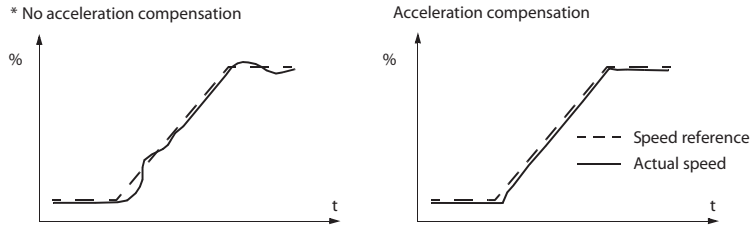
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
SPEED CONTROL (Continued)	**INTEGRATION TIME** (2302)	Default: 0.50 s Range: 0.00 - 600.00 s
		Sets the integration time for the speed controller. • The integration time defines the rate at which the controller output changes for a constant error value. • Shorter integration times correct continuous errors faster. • Control becomes unstable if the integration time is too short. • The figure shows the speed controller output after an error step (error remains constant).  **Note:** You can use parameter 2305 AUTOTUNE RUN to automatically set the integration time.
	DERIVATION TIME (2303)	Default: 0 ms Range: 0 - 10000 ms
		Sets the derivation time for the speed controller. • Derivative action makes the control more responsive to error value changes. • The longer the derivation time, the more the speed controller output is boosted during the change. • If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The figure below shows the speed controller output after an error step when the error remains constant. 
	ACC COMPENSATION (2304)	Default: 0.00 s Range: 0.00 - 600.00 s
		Sets the derivation time for acceleration compensation. • Adding a derivative of the reference to the output of the speed controller compensates for inertia during acceleration. • 2303 DERIVATION TIME describes the principle of derivative action. • Rule of thumb: Set this parameter between 50 and 100% of the sum of the mechanical time constants for the motor and the driven machine. • The figure shows the speed responses when a high inertia load is accelerated along a ramp.  ***Note:** You can use parameter 2305 AUTOTUNE RUN to automatically set acceleration compensation.

Table 7-1 Parameter Definitions Continued

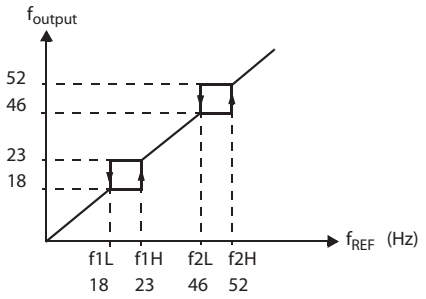
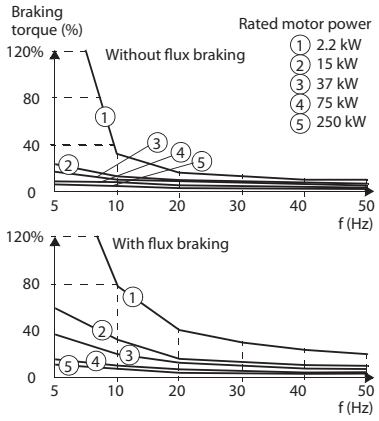
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
SPEED CONTROL (Continued)	**AUTOTUNE RUN** (2305)	Default: 0 (OFF) Range: 0 - 1
	0	OFF – Disables the Autotune creation process. (Does not disable the operation of Autotune settings.)
	1	ON – Activates speed controller autotuning. Automatically reverts to OFF.
		Starts automatic tuning of the speed controller. Procedure: **Note:** The motor load must be connected. • Run the motor at a constant speed of 20 to 40% of the rated speed. • Change the autotuning parameter 2305 to ON. The drive: • Accelerates the motor. • Calculates values for proportional gain, integration time and acceleration compensation. • Changes parameters 2301, 2302 and 2304 to these values. • Resets 2305 to OFF.
CRITICAL SPEEDS	**CRIT SPEED SEL** (2501)	Default: 0 (OFF) Range: 0 - 1
	0	OFF – Disables the critical speeds function.
	1	ON – Enables the critical speeds function.
		Sets the critical speeds function on or off. The critical speed function avoids specific speed ranges. Example: To avoid speeds at which a fan system vibrates badly: • Determine problem speed ranges. Assume they are found to be: 18 - 23 Hz and 46 - 52 Hz. • Set 2501 CRIT SPEED SEL = 1. • Set 2502 CRIT SPEED 1 LO = 18 Hz. • Set 2503 CRIT SPEED 1 HI = 23 Hz. • Set 2504 CRIT SPEED 2 LO = 46 Hz. • Set 2505 CRIT SPEED 2 HI = 52 Hz. 
	CRIT SPEED 1 LO (2502)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Sets the minimum limit for critical speed range 1. • The value must be less than or equal to 2503 CRIT SPEED 1 HI. • Units are rpm, unless 9904 CONTROL TYPE = 2 (V/F CONTROL), then units are Hz.
	CRIT SPEED 1 HI (2503)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Sets the maximum limit for critical speed range 1. • The value must be greater than or equal to 2502 CRIT SPEED 1 LO. • Units are rpm, unless 9904 CONTROL TYPE = 2 (V/F CONTROL), then units are Hz.
	CRIT SPEED 2 LO (2504)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Sets the minimum limit for critical speed range 2. • See parameter 2502.
	CRIT SPEED 2 HI (2505)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Sets the maximum limit for critical speed range 2. • See parameter 2503.
	CRIT SPEED 3 LO (2506)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Sets the minimum limit for critical speed range 3. • See parameter 2502.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
CRITICAL SPEEDS (Continued)	**CRIT SPEED 3 HI** (2507)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Sets the maximum limit for critical speed range 3. • See parameter 2503.
MOTOR CONTROL	**FLUX OPT ENABLE** (2601)	Default: 0 (OFF) Range: 0 - 1
	0	OFF – Disables the feature.
	1	ON – Enables the feature.
		Changes the magnitude of the flux depending on the actual load. Flux Optimization can reduce the total energy consumption and noise, and it should be enabled for drives that usually operate below nominal load.
	FLUX BRAKING (2602)	Default: 0 (OFF) Range: 0 - 1
	0	OFF – Disables the feature.
	1	ON – Enables the feature.
		Provides faster deceleration by raising the level of magnetization in the motor when needed, instead of limiting the deceleration ramp. By increasing the flux in the motor, the energy of the mechanical system is changed to thermal energy in the motor. • Requires parameter 9904 CONTROL TYPE = 1 (OPEN VECTOR). 
	IR COMP VOLT (2603)	Default: Size Dependent Range: 0.0 - 100.0 V
		Sets the IR compensation voltage used for 0 Hz. • Requires parameter 9904 CONTROL TYPE = 2 (V/F CONTROL). • Keep IR compensation as low as possible to prevent overheating. • Typical IR compensation values are:

380 - 480 V drives					
PN (kW)	3	7.5	15	37	132
IR comp (V)	18	15	12	8	3

IR compensation
• When enabled, IR compensation provides an extra voltage boost to the motor at low speeds. Use IR compensation, for example, in applications that require a high breakaway torque.

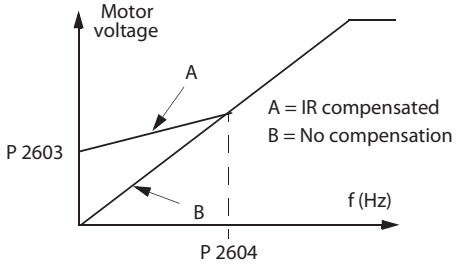
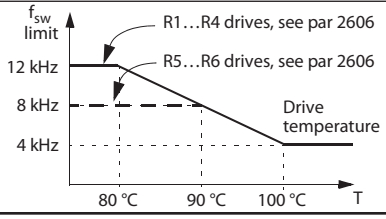


Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
MOTOR CONTROL (Continued)	**IR COMP FREQ** (2604)	Default: 80% Range: 0 - 100%
		Sets the frequency at which IR compensation is 0 V (in % of motor frequency).
	U/F RATIO (2605)	Default: 1 (LINEAR) Range: 1 - 2
	1	LINEAR – Preferred for constant torque applications.
	2	SQUARED – Preferred for centrifugal pump and fan applications. (SQUARED is more silent for most operating frequencies.)
		Selects the form for the U/f (voltage to frequency) ratio below field weakening point.
	SWITCHING FREQ (2606)	Default: 4 kHz Range: 1, 2, 4, 8, 12 kHz
		Sets the switching frequency for the drive. Also see parameter 2607 SWITCH FREQ CTRL and section Switching frequency derating. • Higher switching frequencies mean less noise. • 12 kHz switching frequency is available in scalar control mode, that is when parameter 9904 CONTROL TYPE = 2 (V/F CONTROL). • See the availability of switching frequencies for different drive types in the table below.

	1, 2, 4 and 8 kHz	12 kHz
208 - 240 V	All types	Frame sizes R1 - R4 in scalar control mode
380 - 480 V	All types	Frame sizes R1 - R4 (except ACB530-01-097A-4) in scalar control mode
500 - 600 V	All types	Frame sizes R2 - R4 in scalar control mode

	SWITCH FREQ CTRL (2607)	Default: 1 (ON) Range: 0 - 1
	0	OFF – The function is disabled.
	1	ON – The switching frequency is limited according to the figure.
		The switching frequency may be reduced if the ACB530 internal temperature rises above a limit. See the figure. This function allows the highest possible switching frequency to be used based on operating conditions. Higher switching frequency results in lower acoustic noise.



	SLIP COMP RATIO (2608)	Default: 0% Range: 0 - 200%
		Sets gain for slip compensation (in %). • A squirrel-cage motor slips under load. Increasing the frequency as the motor torque increases compensates for the slip. • Requires parameter 9904 CONTROL TYPE = 2 (V/F CONTROL). 0 – No slip compensation. 1 - 200 – Increasing slip compensation. 100% means full slip compensation.
	NOISE SMOOTHING (2609)	Default: 0 (DISABLE) Range: 0 - 1
	0	DISABLE
	1	ENABLE
		This parameter introduces a random component to the switching frequency. Noise smoothing distributes the acoustic motor noise over a range of frequencies instead of a single tonal frequency resulting in lower peak noise intensity. The random component has an average of 0 Hz. It is added to the switching frequency set by parameter 2606 SWITCHING FREQ. This parameter has no effect if parameter 2606 = 12 kHz.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
MOTOR CONTROL (Continued)	**DC STABILIZER** (2619)	Default: 0 (DISABLE) Range: 0 - 1
	0	DISABLE – Disables DC stabilizer.
	1	ENABLE – Enables DC stabilizer.
		Enables or disables the DC voltage stabilizer. The DC stabilizer is used in scalar control mode to prevent possible voltage oscillations in the drive DC bus caused by motor load or weak supply network. In case of voltage variation the drive tunes the frequency reference to stabilize the DC bus voltage and therefore the load torque oscillation.
FAULT FUNCTIONS	**AI<MIN FUNCTION** (3001)	Default: 0 (NOT SEL) Range: 0 - 3
	0	NOT SEL – No response.
	1	FAULT – Displays a fault (7, AI1 LOSS or 8, AI2 LOSS) and the drive coasts to stop.
	2	CONST SP 7 – Displays an alarm (2006, AI1 LOSS or 2007, AI2 LOSS) and sets speed using 1208 CONST SPEED 7.
	3	LAST SPEED – Displays an alarm (2006, AI1 LOSS or 2007, AI2 LOSS) and sets speed using the last operating level. This value is the average speed over the last 10 seconds.
		Defines the drive response if the analog input (AI) signal drops below the fault limits and AI is used • as the active reference source (Group: REFERENCE SELECT) • as the Process or External PID controllers' feedback or setpoint source (Group: PROCESS PID SET 1, Group: PROCESS PID SET 2. 3021 AI1 FAULT LIMIT and 3022 AI2 FAULT LIMIT set the fault limits. **WARNING! If you select CONST SP 7 or LAST SPEED, make sure that continued operation is safe when the analog input signal is lost.**
	PANEL COMM ERR (3002)	Default: 1 (FAULT) Range: 1 - 3
	1	FAULT – Displays a fault (10, PANEL LOSS) and the drive coasts to stop.
	2	CONST SP 7 – Displays an alarm (2008, PANEL LOSS) and sets speed using 1208 CONST SPEED 7.
	3	LAST SPEED – Displays an alarm (2008, PANEL LOSS) and sets speed using the last operating level. This value is the average speed over the last 10 seconds.
		Defines the drive response to a control panel communication error. **Note:** When either of the two external control locations are active, and start, stop and/or direction are through the control panel – 1001 EXT1 COMMANDS / 1002 EXT2 COMMANDS = 8 (KEYPAD) – the drive follows speed/frequency reference according to the configuration of the external control locations, instead of the value of the last speed or parameter 1208 CONST SPEED 7. **WARNING! If you select CONST SP 7 or LAST SPEED, make sure that continued operation is safe when the control panel communication is lost.**

Table 7-1 Parameter Definitions Continued

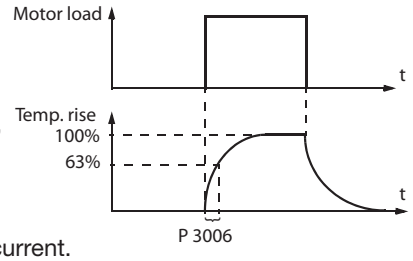
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
FAULT FUNCTIONS (Continued)	**EXTERNAL FAULT 1** (3003)	Default: 0 (NOT SEL) Range: -6 to 6
	0	NOT SEL – External fault signal is not used.
	1	DI1 – Defines digital input DI1 as the external fault input. • Activating the digital input indicates a fault. The drive displays a fault (14, EXT FAULT 1) and the drive coasts to stop.
	2 to 6	DI2 - DI6 – Defines digital input DI2 - DI6 as the external fault input. • See DI1 above.
	-1	DI1 (INV) – Defines an inverted digital input DI1 as the external fault input. • De-activating the digital input indicates a fault. The drive displays a fault (14, EXT FAULT 1) and the drive coasts to stop.
	-2 to -6	DI2 (INV) - DI6 (INV) – Defines an inverted digital input DI2 - DI6 as the external fault input. • See DI1 (INV) above.
		Defines the External Fault 1 signal input and the drive response to an external fault.
	EXTERNAL FAULT 2 (3004)	Default: 0 (NOT SEL) Range: -6 to 6
		Defines the External Fault 2 signal input and the drive response to an external fault. • See parameter 3003 above.
	MOT THERM PROT (3005)	Default: 1 (FAULT) Range: 1 - 2
	0	NOT SEL – No response and/or motor thermal protection not set up.
	1	FAULT – When the calculated motor temperature exceeds 90°C, displays an alarm (2010, MOTOR TEMP). When the calculated motor temperature exceeds 110°C, displays a fault (9, MOT OVERTEMP) and the drive coasts to stop.
	2	ALARM – When the calculated motor temperature exceeds 90°C, displays an alarm (2010, MOTOR TEMP).
		Defines the drive response to motor overheating.
	MOT THERM TIME (3006)	Default: 500 s Range: 256 - 9999 s
		Sets the motor thermal time constant for the motor temperature model. • This is the time required for the motor to reach 63% of the final temperature with steady load. • For thermal protection according to UL requirements for NEMA class motors, use the rule of thumb: MOTOR THERM TIME equals 35 times t6, where t6 (in seconds) is specified by the motor manufacturer as the time that the motor can safely operate at six times its rated current. • The thermal time for a Class 10 trip curve is 350 s, for a Class 20 trip curve 700 s, and for a Class 30 trip curve 1050 s. 

Table 7-1 Parameter Definitions Continued

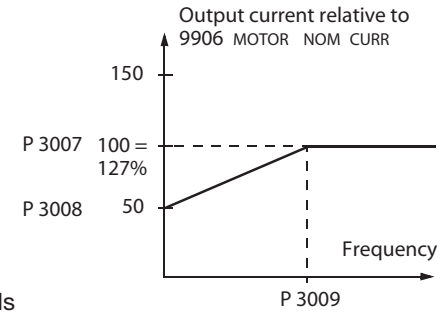
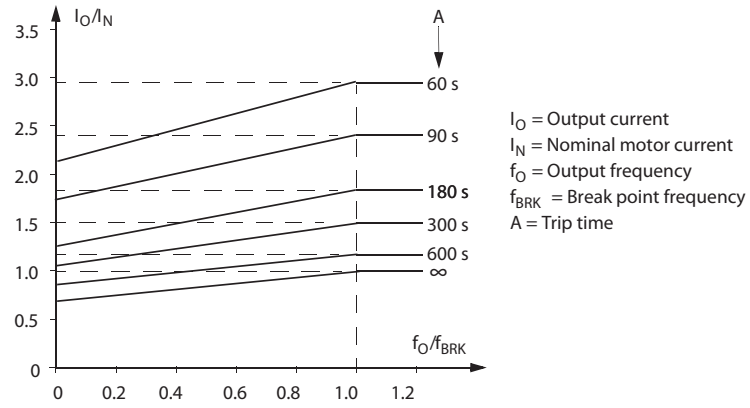
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
FAULT FUNCTIONS (Continued)	**MOT LOAD CURVE** (3007)	Default: 100% Range: 50 - 150%
		Sets the maximum allowable operating load of the motor. • With the default value 100%, motor overload protection is functioning when the constant current exceeds 127% of the parameter 9906 MOTOR NOM CURR value. • The default overloadability is at the same level as what motor manufacturers typically allow below 30°C (86°F) ambient temperature and below 1000 m (3300 ft) altitude. When the ambient temperature exceeds 30°C (86°F) or the installation altitude is over 1000 m (3300 ft), decrease the parameter 3007 value according to the motor manufacturer's recommendation. Example: If the constant protection level needs to be 115% of the motor nominal current, set parameter 3007 value to 91% (= 115/127·100%). 
	ZERO SPEED LOAD (3008)	Default: 70% Range: 25 - 150%
		Sets the maximum allowable current at zero speed. • Value is relative to 9906 MOTOR NOM CURR.
	BREAK POINT FREQ (3009)	Default: 35 Hz Range: 1 - 250 Hz
		Sets the break point frequency for the motor load curve. Example: Thermal protection trip times when parameters 3006 MOT THERM TIME, 3007 MOT LOAD CURVE and 3008 ZERO SPEED LOAD have default values. 

Table 7-1 Parameter Definitions Continued

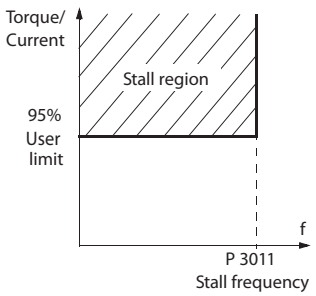
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
FAULT FUNCTIONS (Continued)	**STALL FUNCTION** (3010)	Default: 0 (NOT SEL) Range: 0 - 2
	0	NOT SEL – Stall protection is not used.
	1	FAULT – When the drive operates in the stall region for the time set by 3012 STALL TIME: • The drive coasts to stop. • A fault indication is displayed. 
	2	ALARM – When the drive operates in the stall region for the time set by 3012 STALL TIME: • An alarm indication is displayed. • The alarm disappears when the drive is out of the stall region for half the time set by parameter 3012 STALL TIME.
		This parameter defines the operation of the Stall function. This protection is active if the drive operates in the stall region (see the figure) for the time defined by 3012 STALL TIME. The “User Limit” is defined in Group: LIMITS by 2017 MAX TORQUE 1, 2018 MAX TORQUE 2, or the limit on the COMM input.
	STALL FREQUENCY (3011)	Default: 20.0 Hz Range: 0.5 - 50.0 Hz
		This parameter sets the frequency value for the Stall function. Refer to the figure.
	STALL TIME (3012)	Default: 20 s Range: 10 - 400 s
		This parameter sets the time value for the Stall function.
	EARTH FAULT (3017)	Default: 1 (ENABLE) Range: 0 - 1
	0	DISABLE – No drive response to ground faults. **Note:** Disabling earth fault (ground fault) may void the warranty.
	1	ENABLE – Ground faults display fault 16 (EARTH FAULT), and (if running) the drive coasts to stop.
		Defines the drive response if the drive detects a ground fault in the motor or motor cables. The drive monitors for ground faults while the drive is running, and while the drive is not running. Also see parameter 3023 WIRING FAULT. **NOTE:** EARTH FAULT (3017) can only be modified if the drive is stopped.
	COMM FAULT FUNC (3018)	Default: 0 (NOT SEL) Range: 0 - 3
	0	NOT SEL – No response.
	1	FAULT – Displays a fault (28, SERIAL 1 ERR) and the drive coasts to stop.
	2	CONST SP 7 – Displays an alarm (2005, I/O COMM) and sets speed using 1208 CONST SPEED 7. This “alarm speed” remains active until the fieldbus writes a new reference value.
	3	LAST SPEED – Displays an alarm (2005, I/O COMM) and sets speed using the last operating level. This value is the average speed over the last 10 seconds. This “alarm speed” remains active until the fieldbus writes a new reference value.
		Defines the drive response if the fieldbus communication is lost. **WARNING! If you select CONST SP 7, or LAST SPEED, make sure that continued operation is safe when fieldbus communication is lost.**

Table 7-1 Parameter Definitions Continued

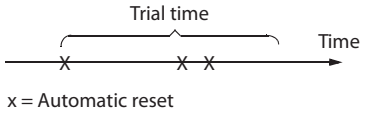
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
FAULT FUNCTIONS (Continued)	**COMM FAULT TIME** (3019)	Default: 3.0 s Range: 0.0 - 600.0 s
		Sets the communication fault time used with 3018 COMM FAULT FUNC. • Brief interruptions in the fieldbus communication are not treated as faults if they are less than the COMM FAULT TIME value.
	AI1 FAULT LIMIT (3021)	Default: 0.0% Range: 0.0 - 100.0%
		Sets a fault level for analog input 1. • See 3001 AI<MIN FUNCTION.
	AI2 FAULT LIMIT (3022)	Default: 0.0% Range: 0.0 - 100.0%
		Sets a fault level for analog input 2. • See 3001 AI<MIN FUNCTION.
	WIRING FAULT (3023)	Default: 1 (ENABLE) Range: 0 - 1
	0	DISABLE – No drive response to either of the above monitoring results. **Note:** Disabling wiring fault (ground fault) may void the warranty.
	1	ENABLE – The drive displays faults when this monitoring detects problems.
		Defines the drive response to cross wiring faults and to ground faults detected when the drive is NOT running. When the drive is not running it monitors for: • Improper connections of input power to the drive output (the drive can display fault 35, OUTPUT WIRING if improper connections are detected). • Ground faults (the drive can display fault 16, EARTH FAULT if a ground fault is detected). Also, see parameter 3017 EARTH FAULT. **NOTE:** WIRING FAULT (3023) can only be modified if the drive is stopped.
	CB TEMP FAULT (3024)	Default: 1 (ENABLE) Range: 0 - 1
	0	DISABLE – No response.
	1	ENABLE – Displays fault 37 (CB OVERTEMP) and the drive coasts to stop.
		Defines the drive response to control board overheating. Not for drives with an OMIO control board.
AUTOMATIC RESET	**NUMBER OF TRIALS** (3101)	Default: 0 Range: 0 - 5
		Sets the number of allowed automatic resets within a trial period defined by 3102 TRIAL TIME. • If the number of automatic resets exceeds this limit (within the trial time), the drive prevents additional automatic resets and remains stopped. • Starting then requires a successful reset performed from the control panel or from a source selected by 1604 FAULT RESET SEL. Example: Three faults have occurred in the trial time. The last is reset only if the value for 3101 NUMBER OF TRIALS is 3 or more. 
	TRIAL TIME (3102)	Default: 30.0 s Range: 1.0 - 600.0 s
		Sets the time period used for counting and limiting the number of resets. • See 3101 NUMBER OF TRIALS.
	DELAY TIME (3103)	Default: 0.0 s Range: 0.0 - 120.0 s
		Sets the delay time between a fault detection and attempted drive restart. • If DELAY TIME = zero, the drive resets immediately.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
AUTOMATIC RESET (Continued)	**AR OVERCURRENT** (3104)	Default: 0 (DISABLE) Range: 0 - 1
	0	DISABLE – Disables automatic reset.
	1	ENABLE – Enables automatic reset. • Automatically resets the fault (OVERCURRENT) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.
		Sets the automatic reset for the overcurrent function on or off.
	AR OVERVOLTAGE (3105)	Default: 0 (DISABLE) Range: 0 - 1
	0	DISABLE – Disables automatic reset.
	1	ENABLE – Enables automatic reset. • Automatically resets the fault (DC OVERVOLT) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.
		Sets the automatic reset for the overvoltage function on or off.
	AR UNDERVOLTAGE (3106)	Default: 0 (DISABLE) Range: 0 - 1
	0	DISABLE – Disables automatic reset.
	1	ENABLE – Enables automatic reset. • Automatically resets the fault (DC UNDERVOLT) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.
		Sets the automatic reset for the undervoltage function on or off.
	AR AI<MIN (3107)	Default: 0 (DISABLE) Range: 0 - 1
	0	DISABLE – Disables automatic reset.
	1	ENABLE – Enables automatic reset. • Automatically resets the fault (AI<MIN) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.
		Sets the automatic reset for the analog input less than minimum value function on or off. **WARNING! When the analog input signal is restored, the drive may restart, even after a long stop. Make sure that automatic, long delayed starts will not cause physical injury and/or damage equipment.**
	AR EXTERNAL FLT (3108)	Default: 0 (DISABLE) Range: 0 - 1
	0	DISABLE – Disables automatic reset.
	1	ENABLE – Enables automatic reset. • Automatically resets the fault (EXT FAULT 1 or EXT FAULT 2) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.
		Sets the automatic reset for external faults function on or off.

Table 7-1 Parameter Definitions Continued

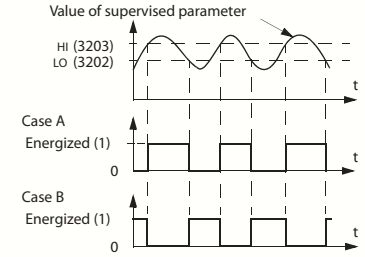
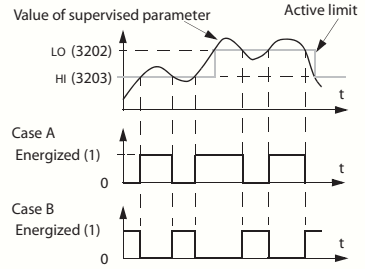
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
SUPERVISION	**SUPERV 1 PARAM** (3201)	Default: 103 (Parameter 0103 OUTPUT FREQ) Range: 100 = NOT SELECTED, 101 - 178
	100	NOT SELECTED – No parameter selected.
	101 - 178	Selects parameter 0101 - 0178.
		Selects the first supervised parameter. • Must be a parameter number from Group: OPERATING DATA. • If the supervised parameter passes a limit, a relay output is energized. • The supervision limits are defined in this group. • The relay outputs are defined in Group: RELAY OUTPUTS (definition also specifies which supervision limit is monitored). **LO ≤ HI** Operating data supervision using relay outputs, when LO≤HI. • Case A = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 OVER or SUPRV2 OVER. Use for monitoring when/if the supervised signal exceeds a given limit. The relay remains active until the supervised value drops below the low limit. • Case B = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 UNDER or SUPRV2 UNDER. Use for monitoring when/if the supervised signal falls below a given limit. The relay remains active until the supervised value rises above the high limit. **LO > HI** Operating data supervision using relay outputs, when LO>HI. The lowest limit (HI 3203) is active initially and remains active until the supervised parameter goes above the highest limit (LO 3202), making that limit the active limit. That limit remains active until the supervised parameter goes below the lowest limit (HI 3203), making that limit active. • Case A = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 OVER or SUPRV2 OVER. Initially the relay is de-energized. It is energized whenever the supervised parameter goes above the active limit. • Case B = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 UNDER or SUPRV2 UNDER. Initially the relay is energized. It is de-energized whenever the supervised parameter goes below the active limit. LO ≤ HI Note: Case LO ≤ HI represents a normal hysteresis.  LO > HI Note: Case LO>HI represents a special hysteresis with two separate supervision limits. 
	SUPERV 1 LIM LO (3202)	Default: Depends on the signal selected with par. 3201 Range:
		Sets the low limit for the first supervised parameter. See 3201 SUPERV 1 PARAM above.
	SUPERV 1 LIM HI (3203)	Default: Depends on the signal selected with par. 3201 Range:
		Sets the high limit for the first supervised parameter. See 3201 SUPERV 1 PARAM above.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
SUPERVISION (Continued)	**SUPERV 2 PARAM** (3204)	Default: 104 (Parameter 0104 CURRENT) Range: 100 = NOT SELECTED, 101 - 178
	100	NOT SELECTED – No parameter selected.
	101 - 178	Selects parameter 0101 - 0178.
		Selects the second supervised parameter. See 3201 SUPERV 1 PARAM above.
	SUPERV 2 LIM LO (3205)	Default: Depends on the signal selected with par. 3204 Range:
		Sets the low limit for the second supervised parameter. See 3204 SUPERV 2 PARAM above.
	SUPERV 2 LIM HI (3206)	Default: Depends on the signal selected with par. 3204 Range:
		Sets the high limit for the second supervised parameter. See 3204 SUPERV 2 PARAM above.
	SUPERV 3 PARAM (3207)	Default: 105 (Parameter 0105 TORQUE) Range: 100 = NOT SELECTED, 101 - 178
	100	NOT SELECTED – No parameter selected.
	101 - 178	Selects parameter 0101 - 0178.
		Selects the third supervised parameter. See 3201 SUPERV 1 PARAM above.
	SUPERV 3 LIM LO (3208)	Default: Depends on the signal selected with par. 3207 Range:
		Sets the low limit for the third supervised parameter. See 3207 SUPERV 3 PARAM above.
	SUPERV 3 LIM HI (3209)	Default: Depends on the signal selected with par. 3207 Range:
		Sets the high limit for the third supervised parameter. See 3207 SUPERV 3 PARAM above.
INFORMATION	**FIRMWARE** (3301)	Default: Firmware version Range: 0000 - FFFF hex
		Contains the version of the drive's firmware.
	LOADING PACKAGE (3302)	Default: Type dependent Range: 0000 - FFFF hex
		Contains the version of the loading package.
	TEST DATE (3303)	Default: Range: yy.ww
		Contains the test date (yy.ww).
	DRIVE RATING (3304)	Default: Type dependent Range:

		Indicates the drive's current and voltage rating. The format is XXXY, where:
		• XXX = The nominal current rating of the drive in amperes. If present, an "A" indicates a decimal point in the rating for the current. For example XXX = 8A8 indicates a nominal current rating of 8.8 A.
		• Y = The voltage rating of the drive, where Y = :
		  • 2 indicates a 208…240 V rating.
		  • 4 indicates a 380…480 V rating.
		  • 6 indicates a 500…600 V rating.

	PARAMETER TABLE (3305)	Default: Type dependent Range: 0000 - FFFF hex
		Contains the version of the parameter table used in the drive.

Table 7-1 Parameter Definitions Continued

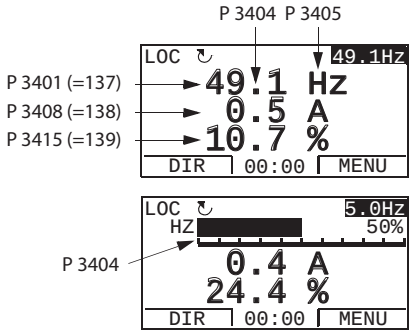
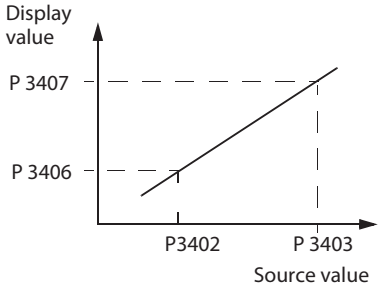
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
PANEL DISPLAY	**SIGNAL1 PARAM** (3401)	Default: 103 (Parameter 0103 OUTPUT FREQ) Range: 100 = NOT SELECTED, 101 - 178
	100	NOT SELECTED – First parameter not displayed.
	101 - 178	Displays parameter 0101 - 0178. If parameter does not exist, the display shows "n.a."
		Selects the first parameter (by number) displayed on the control panel. • Definitions in this group define display content when the control panel is in the control mode. • Any parameter number in Group: OPERATING DATA can be selected. • Using the following parameters, the display value can be scaled, converted to convenient units and/or displayed as a bar graph. • The figure identifies selections made by parameters in this group. • If just one or two parameters are selected for display, that is just one or two of the values of parameters 3401 SIGNAL1 PARAM, 3408 SIGNAL2 PARAM and 3415 SIGNAL3 PARAM are other than 100 (NOT SELECTED), the number and name of each displayed parameter are shown in addition to the value. 
	SIGNAL1 MIN (3402)	Default: Depends on the signal selected with par. 3401 Range:
		Defines the minimum expected value for the first display parameter. Use parameters 3402, 3403, 3406 and 3407, for example to convert a Group: OPERATING DATA parameter, such as 0102 SPEED (in rpm) to the speed of a conveyor driven by the motor (in ft/min). For such a conversion, the source values in the figure are the min. and max. motor speed, and the display values are the corresponding min. and max. conveyor speed. Use parameter 3405 to select the proper units for the display. **Note:** Selecting units does not convert values. Parameter is not effective if parameter 3404 OUTPUT1 DSP FORM = 9 (DIRECT). 
	SIGNAL1 MAX (3403)	Default: Depends on the signal selected with par. 3401 Range:
		Defines the maximum expected value for the first display parameter. **Note:** Parameter is not effective if parameter 3404 OUTPUT1 DSP FORM = 9 (DIRECT).

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
PANEL DISPLAY (Continued)	**OUTPUT1 DSP FORM** (3404)	Default: 9 (DIRECT) Range: 0 - 9
	0 - 7	Defines the decimal point location. • Enter the number of digits desired to the right of the decimal point. • See the table for an example using pi (3.14159).
	8	BAR METER – Specifies a bar meter display.
	9	DIRECT – Decimal point location and units of measure are identical to the source signal. See Group: OPERATING DATA parameter listing in section Complete parameter list for resolution (which indicates the decimal point location) and the units of measure.
		Defines the decimal point location for the first display parameter.
	OUTPUT1 UNIT (3405)	Default: Depends on the signal selected with par. 3401 Range: 0 - 127
		Selects the units used with the first display parameter. **Note:** Parameter is not effective if parameter 3404 OUTPUT1 DSP FORM = 9 (DIRECT).
	OUTPUT1 MIN (3406)	Default: Depends on the signal selected with par. 3401 Range: -
		Sets the minimum value displayed for the first display parameter. **Note:** Parameter is not effective if parameter 3404 OUTPUT1 DSP FORM = 9 (DIRECT).
	OUTPUT1 MAX (3407)	Default: Depends on the signal selected with par. 3401 Range: -
		Sets the maximum value displayed for the first display parameter. **Note:** Parameter is not effective if parameter 3404 OUTPUT1 DSP FORM = 9 (DIRECT).

3404 value	Display	Range
0	± 3	-32768 to +32767 (Signed)
1	± 3.1	
2	± 3.14	
3	± 3.142	
4	3	0 - 65535 (Unsigned)
5	3.1	
6	3.14	
7	3.142	
8	Bar meter displayed	
9	Decimal point location and units as for the source signal	

0 = NO UNIT	9 = °C	18 = MWh	27 = ft	36 = l/s	45 = Pa	54 = lb/m	63 = Mrev
1 = A	10 = lb ft	19 = m/s	28 = MGD	37 = l/min	46 = GPS	55 = lb/h	64 = d
2 = V	11 = mA	20 = m^3/h	29 = inHg	38 = l/h	47 = gal/s	56 = FPS	65 = inWC
3 = Hz	12 = mV	21 = dm^3/s	30 = FPM	39 = m^3/s	48 = gal/m	57 = ft/s	66 = m/min
4 = %	13 = kW	22 = bar	31 = kb/s	40 = m^3/m	49 = gal/h	58 = inH_2O	67 = Nm
5 = s	14 = W	23 = kPa	32 = kHz	41 = kg/s	50 = ft^3/s	59 = in wg	68 = Km^3/h
6 = h	15 = kWh	24 = GPM	33 = ohm	42 = kg/m	51 = ft^3/m	60 = ft wg	
7 = rpm	16 = °F	25 = PSI	34 = ppm	43 = kg/h	52 = ft^3/h	61 = lbsi	
8 = kh	17 = hp	26 = CFM	35 = pps	44 = mbar	53 = lb/s	62 = ms	

The following units are useful for the bar display.

117 = %ref	119 = %dev	121 = % SP	123 = Iout	125 = Fout	127 = Vdc
118 = %act	120 = % LD	122 = %FBK	124 = Vout	126 = Tout	

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
PANEL DISPLAY (Continued)	**SIGNAL2 PARAM** (3408)	Default: 104 (Parameter 0104 CURRENT) Range: 100 = NOT SELECTED, 101 - 178
	100	NOT SELECTED – First parameter not displayed.
	101 - 178	Displays parameter 0101 - 0178. If parameter does not exist, the display shows "n.a."
		Selects the second parameter (by number) displayed on the control panel. See parameter 3401.
	SIGNAL2 MIN (3409)	Default: Depends on the signal selected with par. 3408 Range: -
		Defines the minimum expected value for the second display parameter. See parameter 3402.
	SIGNAL2 MAX (3410)	Default: Depends on the signal selected with par. 3408 Range: -
		Defines the maximum expected value for the second display parameter. See parameter 3403.
	OUTPUT2 DSP FORM (3411)	Default: 9 (DIRECT) Range: 0 - 9
		Defines the decimal point location for the second display parameter. See parameter 3404.
	OUTPUT2 UNIT (3412)	Default: Depends on the signal selected with par. 3408 Range: 0 - 127
		Selects the units used with the second display parameter. See parameter 3405.
	OUTPUT2 MIN (3413)	Default: Depends on the signal selected with par. 3408 Range: -
		Sets the minimum value displayed for the second display parameter. See parameter 3406.
	OUTPUT2 MAX (3414)	Default: Depends on the signal selected with par. 3408 Range: -
		Sets the maximum value displayed for the second display parameter. See parameter 3407.
	SIGNAL3 PARAM (3415)	Default: 105 (Parameter 0105 TORQUE) Range: 100 = NOT SELECTED, 101 - 178
	100	NOT SELECTED – First parameter not displayed.
	101 - 178	Displays parameter 0101 - 0178. If parameter does not exist, the display shows "n.a."
		Selects the third parameter (by number) displayed on the control panel. See parameter 3401.
	SIGNAL3 MIN (3416)	Default: Depends on the signal selected with par. 3415 Range:
		Defines the minimum expected value for the third display parameter. See parameter 3402.
	SIGNAL3 MAX (3417)	Default: Depends on the signal selected with par. 3415 Range:
		Defines the maximum expected value for the third display parameter. See parameter 3403.

Table 7-1 Parameter Definitions Continued

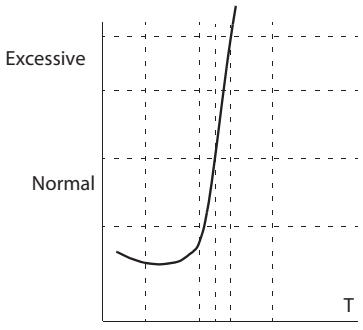
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
PANEL DISPLAY (Continued)	**OUTPUT3 DSP FORM** (3418)	Default: 9 (DIRECT) Range: 0 - 9
		Defines the decimal point location for the third display parameter. See parameter 3404.
	OUTPUT3 UNIT (3419)	Default: Depends on the signal selected with par. 3415 Range: 0 - 127
		Selects the units used with the third display parameter. See parameter 3405.
	OUTPUT3 MIN (3420)	Default: Depends on the signal selected with par. 3415 Range:
		Sets the minimum value displayed for the third display parameter. See parameter 3406.
	OUTPUT3 MAX (3421)	Default: Depends on the signal selected with par. 3415 Range:
		Sets the maximum value displayed for the third display parameter. See parameter 3407.
MOTOR TEMP MEAS	**SENSOR TYPE** (3501)	Default: 0 (NONE) Range: 0 - 6
	0	NONE
	1	1 x PT100 – Sensor configuration uses one PT100 sensor. • Analog output AO1 or AO2 feeds constant current through the sensor. • The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. • The temperature measurement function reads the voltage through analog input AI1 or AI2 and converts it to degrees Celsius.
	2	2 x PT100 – Sensor configuration uses two PT100 sensors. • Operation is the same as for above 1 x PT100.
	3	3 x PT100 – Sensor configuration uses three PT100 sensors. • Operation is the same as for above 1 x PT100.
	4	PTC – Sensor configuration uses one PTC. • The analog output feeds a constant current through the sensor. • The resistance of the sensor increases sharply as the motor temperature rises over the PTC reference temperature (Tref), as does the voltage over the resistor. The temperature measurement function reads the voltage through analog input AI1 and converts it into ohms. • The table below and the graph show typical PTC sensor resistance as a function of the motor operating temperature.  **Temperature** / **Resistance** Normal / < 1.5 kohm Excessive / > 4 kohm

Table 7-1 Parameter Definitions Continued

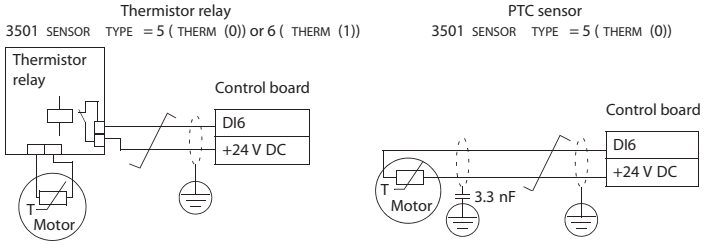
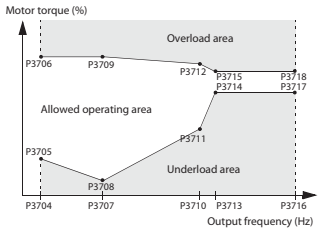
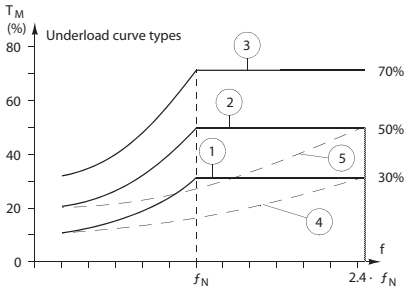
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
MOTOR TEMP MEAS (Continued)	**SENSOR TYPE** (3501) (Continued)	Default: 0 (NONE) Range: 0 - 6
	5	THERM(0) – Sensor configuration uses a thermistor. • Motor thermal protection is activated through a digital input. Connect either a PTC sensor or a normally closed thermistor relay to a digital input. • When the digital input is '0', the motor is overheated. • See the connection figure below.  • The table below and the graph show the resistance requirements for a PTC sensor connected between 24V and a digital input as a function of the motor operating temperature. **Temperature** / **Resistance** Normal / < 3 kohm Excessive / > 28 kohm
	6	THERM(1) – Sensor configuration uses a thermistor. • Motor thermal protection is activated through a digital input. Connect a normally open thermistor relay to a digital input. • When the digital input is '1', the motor is overheated. • See the connection figure above.
		Identifies the type of the motor temperature sensor used, PT100 (°C), PTC (ohm) or thermistor. See parameters 1501 AO1 CONTENT SEL and 1507 AO2 CONTENT SEL.
	INPUT SELECTION (3502)	Default: 1 (AI1) Range: 1 - 8
	1	AI1 – PT100 and PTC.
	2	AI2 – PT100 and PTC.
	3 - 8	DI1 - DI6 – Thermistor and PTC.
		Defines the input used for the temperature sensor.
	ALARM LIMIT (3503)	Default: 110°C / 1500 ohm / 0 Range: Par. 3501 = 1 to 3: -10 to 200°C Par. 3501 = 4: 0 to 5000 ohm Par. 3501 = 5 to 6: 0 to 1
	0	De-activated
	1	Activated
		Defines the alarm limit for motor temperature measurement. • At motor temperatures above this limit, the drive displays an alarm (2010, MOTOR TEMP) For thermistors or PTC connected to a digital input.
	FAULT LIMIT (3504)	Default: 130°C / 4000 ohm / 0 Range: Par. 3501 = 1 to 3: -10 to 200°C Par. 3501 = 4: 0 to 5000 ohm Par. 3501 = 5 to 6: 0 to 1
	0	De-activated
	1	Activated
		Defines the fault limit for motor temperature measurement. • At motor temperatures above this limit, the drive displays a fault (9, MOT OVERTEMP) and stops the drive. For thermistors or PTC connected to a digital input.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
USER LOAD CURVE	**USER LOAD C MODE** (3701)	Default: 0 (NOT SEL) Range: 0 - 3
	0	NOT SEL – Supervision is not active.
	1	UNDERLOAD – Supervision for the torque dropping below the underload curve.
	2	OVERLOAD – Supervision for the torque exceeding the overload curve.
	3	BOTH – Supervision for the torque dropping below the underload curve or exceeding the overload curve.
		Supervision mode for the user adjustable load curves. This functionality replaces the former underload supervision in Group: FAULT FUNCTIONS. To emulate it, see Correspondence with the obsolete underload supervision on next page. 
		Correspondence with the obsolete underload supervision The now obsolete parameter 3015 UNDERLOAD CURVE provided five selectable curves shown in the figure. The parameter characteristics were as described below. • If the load drops below the set curve for longer than the time set by parameter 3014 UNDERLOAD TIME (obsolete), the underload protection is activated. • Curves 1 - 3 reach maximum at the motor rated frequency set by parameter 9907 MOTOR NOM FREQ. • TM = nominal torque of the motor. • ƒN = nominal frequency of the motor.  If you want to emulate the behavior of an old underload curve with parameters as in the shaded columns, set the new parameters as in the white columns in the two tables below:

Underload supervision with parameters 3013 - 3015 (obsolete)	Obsolete parameters		New parameters		
	3013 UNDERLOAD FUNCTION	3014 UNDERLOAD TIME	3701 USER LOAD C MODE	3702 USER LOAD C FUNC	3703 USER LOAD C TIME
No underload functionality	0	-	0	-	-
Underload curve, fault generated	1	t	1	1	t
Underload curve, alarm generated	2	t	1	2	2 · t

Obs. par.	New parameters														
3015 UNDER LOAD CURVE	3704 LOAD FREQ 1 (Hz)		3705 LOAD TORQ LOW 1 (%)	3707 LOAD FREQ 2 (Hz)		3708 LOAD TORQ LOW 2 (%)	3710 LOAD FREQ 3 (Hz)		3711 LOAD TORQ LOW 3 (%)	3713 LOAD FREQ 4 (Hz)		3714 LOAD TORQ LOW 4 (%)	3716 LOAD FREQ 5 (Hz)		3717 LOAD TORQ LOW 5 (%)
	EU	US		EU	US		EU	US		EU	US		EU	US	
1	5	6	10	32	38	17	41	50	23	50	60	30	500	500	30
2	5	6	20	31	37	30	42	50	40	50	60	50	500	500	50
3	5	6	30	31	37	43	42	50	57	50	60	70	500	500	70
4	5	6	10	73	88	17	98	117	23	120	144	30	500	500	30
5	5	6	20	71	86	30	99	119	40	120	144	50	500	500	50

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
USER LOAD CURVE (Continued)	**USER LOAD C FUNC** (3702)	Default: 1 (FAULT) Range: 1 - 2
	1	FAULT – A fault is generated when the condition defined by 3701 USER LOAD C MODE has been valid longer than the time set by 3703 USER LOAD C TIME.
	2	ALARM – An alarm is generated when the condition defined by 3701 USER LOAD C MODE has been valid longer than half of the time defined by 3703 USER LOAD C TIME.
		Action wanted during load supervision.
	USER LOAD C TIME (3703)	Default: 20 s Range: 10 - 400 s
		Defines the time limit for generating a fault. • Half of this time is used as the limit for generating an alarm.
	LOAD FREQ 1 (3704)	Default: 5 Hz Range: 0 - 500 Hz
		Defines the frequency value of the first load curve definition point. • Must be smaller than 3707 LOAD FREQ 2.
	LOAD TORQ LOW 1 (3705)	Default: 10% Range: 0 - 600%
		Defines the torque value of the first underload curve definition point. • Must be smaller than 3706 LOAD TORQ HIGH 1.
	LOAD TORQ HIGH 1 (3706)	Default: 300% Range: 0 - 600%
		Defines the torque value of the first overload curve definition point.
	LOAD FREQ 2 (3707)	Default: 25 Hz Range: 0 - 500 Hz
		Defines the frequency value of the second load curve definition point. • Must be smaller than 3710 LOAD FREQ 3.
	LOAD TORQ LOW 2 (3708)	Default: 15% Range: 0 - 600%
		Defines the torque value of the second underload curve definition point. • Must be smaller than 3709 LOAD TORQ HIGH 2.
	LOAD TORQ HIGH 2 (3709)	Default: 300% Range: 0 - 600%
		Defines the torque value of the second overload curve definition point.
	LOAD FREQ 3 (3710)	Default: 43 Hz Range: 0 - 500 Hz
		Defines the frequency value of the third load curve definition point. • Must be smaller than 3713 LOAD FREQ 4.
	LOAD TORQ LOW 3 (3711)	Default: 25% Range: 0 - 600%
		Defines the torque value of the third underload curve definition point. • Must be smaller than 3712 LOAD TORQ HIGH 3.
	LOAD TORQ HIGH 3 (3712)	Default: 300% Range: 0 - 600%
		Defines the torque value of the third overload curve definition point.
	LOAD FREQ 4 (3713)	Default: 50 Hz Range: 0 - 500 Hz
		Defines the frequency value of the fourth load curve definition point. • Must be smaller than 3716 LOAD FREQ 5.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
USER LOAD CURVE (Continued)	**LOAD TORQ LOW 4** (3714)	Default: 30% Range: 0 - 600%
		Defines the torque value of the fourth underload curve definition point. • Must be smaller than 3715 LOAD TORQ HIGH 4.
	LOAD TORQ HIGH 4 (3715)	Default: 300% Range: 0 - 600%
		Defines the torque value of the fourth overload curve definition point.
	LOAD FREQ 5 (3716)	Default: 500 Hz Range: 0 - 500 Hz
		Defines the frequency value of fifth load curve definition point.
	LOAD TORQ LOW 5 (3717)	Default: 30% Range: 0 - 600%
		Defines the torque value of the fifth underload curve definition point. • Must be smaller than 3718 LOAD TORQ HIGH 5.
	LOAD TORQ HIGH 5 (3718)	Default: 300% Range: 0 - 600%
		Defines the torque value of the fifth overload curve definition point.
PROCESS PID SET 1	**GAIN** (4001)	Default: 1.0 Range: 0.1 - 100.0
		Defines the PID controller's gain. • The setting range is 0.1 - 100. • At 0.1, the PID controller output changes one-tenth as much as the error value. • At 100, the PID controller output changes one hundred times as much as the error value. Use the proportional gain and integration time values to adjust the responsiveness of the system. • A low value for proportional gain and a high value for integral time ensures stable operation, but provides sluggish response. If the proportional gain value is too large or the integral time too short, the system can become unstable. Procedure: • Initially, set: • 4001 GAIN = 0.1. • 4002 INTEGRATION TIME = 20 seconds. • Start the system and see if it reaches the setpoint quickly while maintaining stable operation. If not, increase GAIN (4001) until the actual signal (or drive speed) oscillates constantly. It may be necessary to start and stop the drive to induce this oscillation. • Reduce GAIN (4001) until the oscillation stops. • Set GAIN (4001) to 0.4 to 0.6 times the above value. • Decrease the INTEGRATION TIME (4002) until the feedback signal (or drive speed) oscillates constantly. It may be necessary to start and stop the drive to induce this oscillation. • Increase INTEGRATION TIME (4002) until the oscillation stops. • Set INTEGRATION TIME (4002) to 1.15 to 1.5 times the above value. • If the feedback signal contains high frequency noise, increase the value of parameter 1303 FILTER AI1 or 1306 FILTER AI2 until the noise is filtered from the signal.

Table 7-1 Parameter Definitions Continued

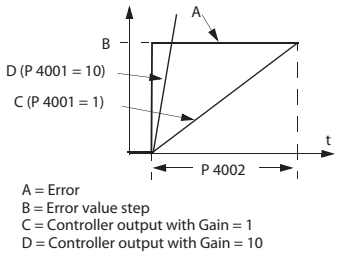
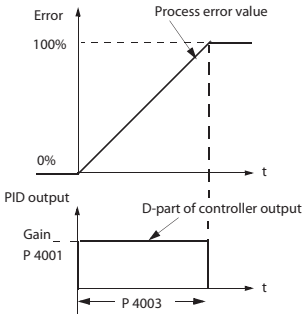
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
PROCESS PID SET 1 (Continued)	**INTEGRATION TIME** (4002)	Default: 60.0 s Range: 0.0 = (NOT SEL), 0.1 - 3600.0 s
	0.0	NOT SEL – Disables integration (I-part of controller).
	0.1 - 3600.0 s	Integration time (seconds).
		Defines the PID controller's integration time. Integration time is, by definition, the time required to increase the output by the error value: • Error value is constant and 100%. • Gain = 1. • Integration time of 1 second denotes that a 100% change is achieved in 1 second. • See 4001 for adjustment procedure.  A = Error B = Error value step C = Controller output with Gain = 1 D = Controller output with Gain = 10
	DERIVATION TIME (4003)	Default: 0.0 s Range: 0.0 - 10.0 s
		Defines the PID controller's derivation time. • You can add the derivative of the error to the PID controller output. The derivative is the error value's rate of change. For example, if the process error value changes linearly, the derivative is a constant added to the PID controller output. • The error-derivative is filtered with a 1-pole filter. The time constant of the filter is defined by parameter 4004 PID DERIV FILTER. 0.0 - 10.0 – Derivation time (seconds). 
	PID DERIV FILTER (4004)	Default: 1.0 s Range: 0.0 - 10.0 s
		Defines the filter time constant for the error-derivative part of the PID controller output. • Before being added to the PID controller output, the error-derivative is filtered with a 1-pole filter. • Increasing the filter time smooths the error-derivative, reducing noise. 0.0 - 10.0 – Filter time constant (seconds).
	ERROR VALUE INV (4005)	Default: 0 (NO) Range: 0 - 1
	0	NO – Normal, a decrease in feedback signal increases drive speed. Error = Ref - Fbk
	1	YES – Inverted, a decrease in feedback signal decreases drive speed. Error = Fbk - Ref
		Selects either a normal or inverted relationship between the feedback signal and the drive speed.
	UNITS (4006)	Default: 4 (%) Range: 0 - 127
		Selects the unit for the PID controller actual values. (PID1 parameters 0128, 0130 and 0132). • See parameter 3405 for list of available units.

Table 7-1 Parameter Definitions Continued

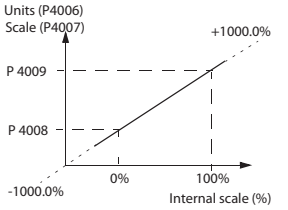
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
PROCESS PID SET 1 (Continued)	**UNIT SCALE** (4007)	Default: 1 Range: 0 - 4
		Defines the decimal point location in PID controller actual values. • Enter the decimal point location counting in from the right end of the entry. • See the table for an example using pi (3.14159). **4007 value / Entry / Display** 0 / 00003 / 3 1 / 00031 / 3.1 2 / 00314 / 3.14 3 / 03142 / 3.142 4 / 31416 / 3.1416
	0% VALUE (4008)	Default: 0.0 Range: Unit and scale defined by par. 4006 and 4007
		0% VALUE Defines (together with the next parameter) the scaling applied to the PID controller's actual values (PID1 parameters 0128, 0130 and 0132). • Units and scale are defined by parameters 4006 and 4007.  REG BYPASS CTRL).
	100% VALUE (4009)	Default: 100.0 Range: Unit and scale defined by par. 4006 and 4007
		0% VALUE Defines (together with the previous parameter) the scaling applied to the PID controller's actual values. • Units and scale are defined by parameters 4006 and 4007.
	SET POINT SEL (4010)	Default: (1) AI1 Range: 0 - 2, 8 - 17, 19
	0	KEYPAD - Keypad
	1	AI1 - Analog Input AI1
	2	AI2 - Analog Input AI2
	8	COMM - Fieldbus reference REF 2
	9	COMM+ AI1- Summation of fieldbus reference REF2 and analog input AI1.
	10	COMM*AI2 -Multiplication of fieldbus reference REF2 and analog input AI1.
	11	DI3U, 4D (RNC) -Digital Input DI3: Reference increase. Digital Input DI4: Reference decrease. Stop command resets the reference to zero. The reference is not saved if the control source is changed from EXT1 to EXT2, from EXT2 to EXT1 or from LOC to REM.
	12	DI3U, 4D (NC) - Digital Input DI3: Reference increase. Digital Input DI4: Reference decrease. The program stores the reference (not reset by a stop command). The reference is not saved if the control source is changed from EXT1 to EXT2, from EXT2 to EXT1 or from LOC to REM.
	14	AI1+AI2 - Reference is calculated with the following equation: REF = AI1(%) + AI2(%) - 50%
	15	AI1*AI2 -Reference is calculated with the following equation: REF = AI1(%) * AI2(%) - 50%
	16	AI1-AI2 - Reference is calculated with the following equation: REF = AI1(%) + 50% - AI2(%)
	17	AI1/AI2 - Reference is calculated with the following equation: REF = AI1(%) + (50% / AI2(%))
	19	INTERNAL - A constant value defined by parameter 4011 INTERNAL SETPNT.
		Selects the source for the process PID controller reference signal.

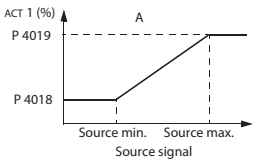
Table 7-1 Parameter Definitions Continued

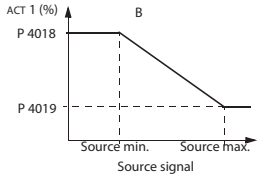
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
PROCESS PID SET 1 (Continued)	**INTERNAL SETPNT** (4011)	Default: 40.0 Range: Unit and scale defined by par. 4006 and 4007
		Sets a constant value used for the process reference. • Units and scale are defined by parameters 4006 and 4007.
	SETPOINT MIN (4012)	Default: 0.0% Range: -500.0 to 500.0
		Sets the minimum value for the reference signal source. • See parameter 4010.
	SETPOINT MAX (4013)	Default: 100.0% Range: -500.0 to 500.0
		Sets the maximum value for the reference signal source. • See parameter 4010.
	FBK SEL (4014)	Default: 1 (ACT1) Range: 1 - 13
	1	ACT1 – Actual value 1 (ACT1) provides the feedback signal.
	2	ACT1-ACT2 – ACT1 minus ACT2 provides the feedback signal.
	3	ACT1+ACT2 – ACT1 plus ACT2 provides the feedback signal.
	4	ACT1*ACT2 – ACT1 times ACT2 provides the feedback signal.
	5	ACT1/ACT2 – ACT1 divided by ACT2 provides the feedback signal.
	6	MIN(ACT1,2) – The smaller of ACT1 or ACT2 provides the feedback signal.
	7	MAX(ACT1,2) – The greater of ACT1 or ACT2 provides the feedback signal.
	8	sqrt(ACT1-2) – Square root of the value for ACT1 minus ACT2 provides the feedback signal.
	9	sqA1+sqA2 – Square root of ACT1 plus the square root of ACT2 provides the feedback signal.
	10	sqrt(ACT1) – Square root of ACT1 provides the feedback signal.
	11	COMM FBK 1 – Signal 0158 PID COMM VALUE 1 provides the feedback signal.
	12	COMM FBK 2 – Signal 0159 PID COMM VALUE 2 provides the feedback signal.
	13	AVE(ACT1,2) – The average of ACT1 and ACT2 provides the feedback signal.
		Defines the PID controller feedback (actual signal). • You can define a combination of two actual values (ACT1 and ACT2) as the feedback signal. • Use parameter 4016 to define the source for actual value 1 (ACT1). • Use parameter 4017 to define the source for actual value 2 (ACT2).
	FBK MULTIPLIER (4015)	Default: 0.000 (NOT SEL) Range: 0.000 = (NOT SEL), -32.768 to 32.767
	0.000	NOT SEL – The parameter has no effect (1.000 used as the multiplier).
	-32.768 to 32.767	Multiplier applied to the signal defined by parameter 4014 FBK SEL. Example: FBK = Multiplier × √A1 – A2
		Defines an extra multiplier for the PID feedback value FBK defined by parameter 4014. • Used mainly in applications where the flow is calculated from the pressure difference.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
PROCESS PID SET 1 (Continued)	**ACT1 INPUT** (4016)	Default: 2 (AI2) Range: 1 - 7
	1	AI1 – Uses analog input 1 for ACT1.
	2	AI2 – Uses analog input 2 for ACT1.
	3	CURRENT – Uses current for ACT1.
	4	TORQUE – Uses torque for ACT1.
	5	POWER – Uses power for ACT1.
	6	COMM ACT 1 – Uses value of signal 0158 PID COMM VALUE 1 for ACT1.
	7	COMM ACT 2 – Uses value of signal 0159 PID COMM VALUE 2 for ACT1.
		Defines the source for actual value 1 (ACT1). See also parameter 4018 ACT1 MINIMUM. **NOTE:** ACT1 INPUT (4016) can only be modified if the drive is stopped.
	ACT2 INPUT (4017)	Default: 2 (AI2) Range: 1 - 7
	1	AI1 – Uses analog input 1 for ACT2.
	2	AI2 – Uses analog input 2 for ACT2.
	3	CURRENT – Uses current for ACT2.
	4	TORQUE – Uses torque for ACT2.
	5	POWER – Uses power for ACT2.
	6	COMM ACT 1 – Uses value of signal 0158 PID COMM VALUE 1 for ACT2.
	7	COMM ACT 2 – Uses value of signal 0159 PID COMM VALUE 2 for ACT2.
		Defines the source for actual value 2 (ACT2). See also parameter 4020 ACT2 MINIMUM. **NOTE:** ACT2 INPUT (4017) can only be modified if the drive is stopped.
	ACT1 MINIMUM (4018)	Default: 0% Range: -1000 to 1000%
		Sets the minimum value for ACT1. • Scales the source signal used as the actual value ACT1 (defined by parameter 4016 ACT1 INPUT). For parameter 4016 values 6 (COMM ACT 1) and 7 (COMM ACT 2) scaling is not done.

Par 4016	Source	Source min.	Source max.
1	Analog input 1	1301 MINIMUM AI1	1302 MAXIMUM AI1
2	Analog input 2	1304 MINIMUM AI2	1305 MAXIMUM AI2
3	Current	0	2 · nominal current
4	Torque	-2 · nominal torque	2 · nominal torque
5	Power	-2 · nominal power	2 · nominal power





	ACT1 MAXIMUM (4019)	Default: 100% Range: -1000 to 1000%
		Sets the maximum value for ACT1. • See 4018 ACT1 MINIMUM.
	ACT2 MINIMUM (4020)	Default: 0% Range: -1000 to 1000%
		Sets the minimum value for ACT2. • See 4018 ACT1 MINIMUM.

Table 7-1 Parameter Definitions Continued

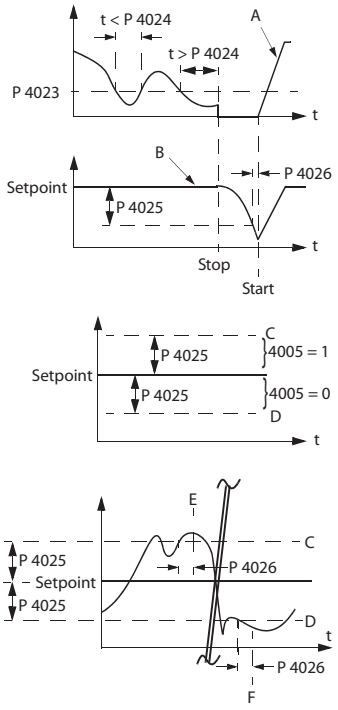
Group	Parameter (Number) Selection (Value)	Parameter Name and Description
PROCESS PID SET 1 (Continued)	**ACT2 MAXIMUM** (4021)	Default: 100% Range: -1000 to 1000%
		Sets the maximum value for ACT2. • See 4018 ACT1 MINIMUM.
	SLEEP SELECTION (4022)	Default: 0 (NOT SEL) Range: -6 to 7
	0	NOT SEL– Disables the PID sleep control function.
	1	DI1 – Defines digital input DI1 as the control for the PID sleep function. • Activating the digital input activates the sleep function. • De-activating the digital input restores PID control.
	2 to 6	DI2 - DI6 – Defines digital input DI2 - DI6 as the control for the PID sleep function. • See DI1 above.
	7	INTERNAL – Defines the output rpm/frequency, process reference and process actual value as the control for the PID sleep function. Refer to parameters 4025 WAKE-UP DEV and 4023 PID SLEEP LEVEL.
	-1	DI1 (INV) – Defines an inverted digital input DI1 as the control for the PID sleep function. • De-activating the digital input activates the sleep function. • Activating the digital input restores PID control.
	-2 to -6	DI2 (INV) - DI6 (INV) – Defines an inverted digital input DI2 - DI6 as the control for the PID sleep function. • See DI1 (INV) above.
		Defines the control for the PID sleep function.
	PID SLEEP LEVEL (4023)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM
		Sets the motor speed / frequency that enables the PID sleep function – a motor speed / frequency below this level, for at least the time period 4024 PID SLEEP DELAY enables the PID sleep function (stopping the drive). • Requires 4022 = 7 (INTERNAL). • See the figure: A = PID output level; B = PID process feedback. 

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
PROCESS PID SET 1 (Continued)	**PID SLEEP DELAY** (4024)	Default: 60.0 s Range: 0.0 - 3600.0 s
		Sets the time delay for the PID sleep function – a motor speed / frequency below 4023 PID SLEEP LEVEL for at least this time period enables the PID sleep function (stopping the drive). • See 4023 PID SLEEP LEVEL above.
	WAKE-UP DEV (4025)	Default: 0.0s Range: Unit and scale defined by par. 4006 and 4007
		Defines the wake-up deviation – a deviation from the setpoint greater than this value, for at least the time period 4026 WAKE-UP DELAY, re-starts the PID controller. • Parameters 4006 and 4007 define the units and scale. • Parameter 4005 = 0, Wake-up level = Setpoint - Wake-up deviation. • Parameter 4005 = 1, Wake-up level = Setpoint + Wake-up deviation. • Wake-up level can be above or below setpoint. See the figures: • C = Wake-up level when parameter 4005 = 1 • D = Wake-up level when parameter 4005 = 0 • E = Feedback is above wake-up level and lasts longer than 4026 WAKE-UP DELAY – PID function wakes up. • F = Feedback is below wake-up level and lasts longer than 4026 WAKE-UP DELAY – PID function wakes up.
	WAKE-UP DELAY (4026)	Default: 0.50 s Range: 0.0 - 60.00 s
		Defines the wake-up delay – a deviation from the setpoint greater than 4025 WAKE-UP DEV, for at least this time period, re-starts the PID controller.
ENERGY SAVING	**ENERGY PRICE** (4502)	Default: 0.00 Range: 0.00 - 655.35
		Price of energy per kWh. • Used for reference when energy savings are calculated. • See parameters 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 and 0178 SAVED CO2 (reduction on carbon dioxide emissions in tn).
	CO2 CONV FACTOR (4507)	Default: 0.5 tn/MWh Range: 0.00 - 10.0 tn/MWh
		Conversion factor for converting energy into CO2 emissions (kg/kWh or tn/MWh). Used for multiplying the saved energy in MWh to calculate the value of parameter 0178 SAVED CO2 (reduction on carbon dioxide emissions in tn).
	PUMP POWER (4508)	Default: 100.0% Range: 0.0 - 1000.0%
		Pump power (as a percentage of the nominal motor power) when connected directly to supply (DOL). • Used for reference when energy savings are calculated. • See parameters 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 and 0178 SAVED CO2. • It is possible to use this parameter as the reference power also for other applications than pumps. The reference power can also be some other constant power than a motor connected directly online.
	ENERGY RESET (4509)	Default: 0 (DONE) Range: 0 - 1
	0	DONE
	1	RESET
		Resets energy calculators 0174 SAVED KWH, 0175 SAVED MWH, 0176 SAVED AMOUNT 1, 0177 SAVED AMOUNT 2 and 0178 SAVED CO2.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
EXT COMM MODULE	**FBA TYPE** (5101)	Default: READ ONLY Range: -
	0	NOT DEFINED – Module not found, or not properly connected, or parameter 9802 is not set to 4 (EXT FBA).
	1	PROFIBUS-DP
	32	CANopen
	37	DEVICENET
	101	CONTROLNET
	128	ETHERNET
	132	PROFINET
	135	EtherCAT
	136	EPL – Ethernet POWERLINK
		Displays the type of the connected fieldbus adapter module.
	FB PAR 2 - FB PAR 26 (5102 - 5106)	Default: 0 Range: 0 - 65535
		Refer to communication module documentation for more information on these parameters.
	FBA PAR REFRESH (5127)	Default: 0 (DONE) Range: 0 - 1
	0	DONE – Refreshing done.
	1	REFRESH – Refreshing. • After refreshing, the value reverts automatically to DONE.
		Validates any changed fieldbus parameter settings. **NOTE:** FBA PAR REFRESH (5127) can only be modified if the drive is stopped.
	FILE CPI FW REV (5128)	Default: READ ONLY Range: -
		Displays the CPI firmware revision of the drive's fieldbus adapter configuration file. Format is xyz where: • x = major revision number • y = minor revision number • z = correction number Example: 107 = revision 1.07.
	FILE CONFIG ID (5129)	Default: READ ONLY Range: -
		Displays the revision of the drive's fieldbus adapter module's configuration file identification. • File configuration information is drive application program-dependent.
	FILE CONFIG REV (5130)	Default: READ ONLY Range: -
		Contains the revision of the drive's fieldbus adapter module configuration file. Example: 1 = revision 1

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
EXT COMM MODULE (Continued)	**FBA STATUS** (5131)	Default: READ ONLY Range: -
	0	IDLE – Adapter not configured.
	1	EXECUT INIT – Adapter is initializing.
	2	TIME OUT – A timeout has occurred in the communication between the adapter and the drive.
	3	CONFIG ERROR – Adapter configuration error. • The revision code of the adapter's CPI firmware revision is older than required CPI firmware version defined in the drive's configuration file (parameter 5132 < 5128).
	4	OFF-LINE – Adapter is off-line.
	5	ON-LINE – Adapter is on-line.
	6	RESET – Adapter is performing a hardware reset.
		Contains the status of the adapter module.
	FBA CPI FW REV (5132)	Default: READ ONLY Range: -
		Contains the revision of the module's CPI program. Format is xyz where: • x = major revision number • y = minor revision number • z = correction number Example: 107 = revision 1.07
	FBA APPL FW REV (5133)	Default: READ ONLY Range: -
		Contains the revision of the module's application program. Format is xyz (see parameter 5132).
PANEL COMM	**STATION ID** (5201)	Default: 1 Range: 1 - 247
		Defines the address of the drive. • Two units with the same address are not allowed on-line.
	BAUD RATE (5202)	Default: 9.6 kbits/s Range: 9.6, 19.2, 38.4, 57.6, 115.2 kbits/s
		Defines the communication speed of the drive in kbits per second (kb/s).
	PARITY (5203)	Default: 0 (8 NONE 1) Range: 0 - 3
	0	8 NONE 1 – 8 data bits, no parity, one stop bit.
	1	8 NONE 2 – 8 data bits, no parity, two stop bits.
	2	8 EVEN 1 – 8 data bits, even parity, one stop bit.
	3	8 ODD 1 – 8 data bits, odd parity, one stop bit.
		Sets the character format to be used with the panel communication.
	OK MESSAGES (5204)	Default: READ ONLY Range: -
		Contains a count of valid Modbus messages received by the drive. • During normal operation, this counter is increasing constantly.
	PARITY ERRORS (5205)	Default: READ ONLY Range: -
		Contains a count of the characters with a parity error that is received from the bus. For high counts, check: • Parity settings of devices connected on the bus – they must not differ. • Ambient electro-magnetic noise levels – high noise levels generate errors.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
PANEL COMM (Continued)	**FRAME ERRORS** (5206)	Default: READ ONLY Range: -
		Contains a count of the characters with a framing error that the bus receives. For high counts, check: • Communication speed settings of devices connected on the bus – they must not differ. • Ambient electro-magnetic noise levels – high noise levels generate errors.
	BUFFER OVERRUNS (5207)	Default: READ ONLY Range: -
		Contains a count of the characters received that cannot be placed in the buffer. • Longest possible message length for the drive is 128 bytes. • Received messages exceeding 128 bytes overflow the buffer. The excess characters are counted.
	CRC ERRORS (5208)	Default: READ ONLY Range: -
		Contains a count of the messages with a CRC error that the drive receives. For high counts, check: • Ambient electro-magnetic noise levels – high noise levels generate errors. • CRC calculations for possible errors.
EFB PROTOCOL	**EFB PROTOCOL ID** (5301)	Default: 0 Range: 0 - 0 x FFFF
		Contains the identification and program revision of the protocol. • Format: XXYY, where xx = protocol ID, and YY = program revision.
	EFB STATION ID (5302)	Default: 1 Range: 0 - 65535
		Defines the node address of the RS485 link. • The node address on each unit must be unique. **NOTE:** EFB STATION ID (5302) can only be modified if the drive is stopped.
	EFB BAUD RATE (5303)	Default: 9.6 kbits/s Range: 1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6, 76.8 kbits/s
		Defines the communication speed of the RS485 link in kbits per second (kb/s).
	EFB PARITY (5304)	Default: 0 (8 NONE 1) Range: 0 - 3
	0	8 NONE 1 – 8 data bits, no parity, one stop bit.
	1	8 NONE 2 – 8 data bits, no parity, two stop bits.
	2	8 EVEN 1 – 8 data bits, even parity, one stop bit.
	3	8 ODD 1 – 8 data bits, odd parity, one stop bit.
		Defines the data length, parity and stop bits to be used with the RS485 link communication. • The same settings must be used in all on-line stations.
	EFB CTRL PROFILE (5305)	Default: 0 (ABB DRV LIM) Range: 0 - 2
	0	ABB DRV LIM – Operation of Control/Status Words conforms to ABB Drives Profile, as used in ACS400.
	1	DCU PROFILE – Operation of Control/Status Words conforms to 32-bit DCU Profile.
	2	ABB DRV FULL – Operation of Control/Status Words conforms to ABB Drives Profile, as used in ACS600/800.
		Selects the communication profile used by the EFB protocol.
	EFB OK MESSAGES (5306)	Default: READ ONLY Range: -
		Contains a count of valid messages received by the drive. • During normal operation, this counter is increasing constantly.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
EFB PROTOCOL (Continued)	**EFB CRC ERRORS** (5307)	Default: READ ONLY Range: -
		Contains a count of the messages with a CRC error received by the drive. For high counts, check: • Ambient electro-magnetic noise levels – high noise levels generate errors. • CRC calculations for possible errors.
	EFB UART ERRORS (5308)	Default: READ ONLY Range: -
		Contains a count of the messages with a character error received by the drive.
	EFB STATUS (5309)	Default: READ ONLY Range: -
	0	IDLE – EFB protocol is configured, but not receiving any messages.
	1	EXECUT INIT – EFB protocol is initializing.
	2	TIME OUT – A timeout has occurred in the communication between the network master and the EFB protocol.
	3	CONFIG ERROR – EFB protocol has a configuration error.
	4	OFF-LINE – EFB protocol is receiving messages that are NOT addressed to this drive.
	5	ON-LINE – EFB protocol is receiving messages that are addressed to this drive.
	6	RESET – EFB protocol is performing a hardware reset
	7	LISTEN ONLY – EFB protocol is in listen-only mode.
		Contains the status of the EFB protocol.
	EFB PAR 10 (5310)	Default: 0 Range: 0 - 65535
		Specifies the parameter mapped to Modbus Register 40005.
	EFB PAR 11 (5311)	Default: 0 Range: 0 - 65535
		Specifies the parameter mapped to Modbus Register 40006.
	EFB PAR 12 (5312)	Default: 0 Range: 0 - 65535
		Specifies the parameter mapped to Modbus Register 40007.
	EFB PAR 13 (5313)	Default: 0 Range: 0 - 65535
		Specifies the parameter mapped to Modbus Register 40008.
	EFB PAR 14 (5314)	Default: 0 Range: 0 - 65535
		Specifies the parameter mapped to Modbus Register 40009.
	EFB PAR 15 (5315)	Default: 0 Range: 0 - 65535
		Specifies the parameter mapped to Modbus Register 40010.
	EFB PAR 16 (5316)	Default: 0 Range: 0 - 65535
		Specifies the parameter mapped to Modbus Register 40011.
	EFB PAR 17 (5317)	Default: 0 Range: 0 - 65535
		Specifies the parameter mapped to Modbus Register 40012.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
EFB PROTOCOL (Continued)	**EFB PAR 18** (5318)	Default: 0 Range: 0 - 65535
		For Modbus: Sets additional delay in milliseconds before the ACB530 begins transmitting response to the master request.
	EFB PAR 19 (5319)	Default: 0 Range: 0000 - FFFF hex
		Baldor Drives profile (Baldor DRV LIM or Baldor DRV FULL) Control Word. Read only copy of the Fieldbus Control Word.
	EFB PAR 20 (5320)	Default: 0 Range: 0000 - FFFF hex
		Baldor Drives profile (Baldor DRV LIM or Baldor DRV FULL) Status Word. Read only copy of the Fieldbus Status Word.
LOAD ANALYZER	**PVL SIGNAL** (6401)	Default: 103 (parameter 0103 OUTPUT FREQ) Range: 100 - 178
	100	NOT SELECTED – No signal (parameter) logged for the peak value.
	101 - 178	Logs parameter 0101 - 0178.
		Defines (by number) the signal logged for the peak value. • Any parameter number in Group: OPERATING DATA can be selected. Eg 102 = parameter 0102 SPEED.
	PVL FILTER TIME (6402)	Default: 0.1 s Range: 0.0 - 120.0 s
		Defines the filter time in seconds for peak value logging.
	LOGGERS RESET (6403)	Default: 0 (NOT SEL) Range: -6 to 7
	0	NOT SEL – No reset selected.
	1	DI1 – Reset loggers on the rising edge of digital input DI1.
	2 to 6	DI2 - DI6 – Reset loggers on the rising edge of digital input DI2 - DI6.
	7	RESET – Reset loggers. Parameter is set to NOT SEL.
	-1	DI1 (INV) – Reset loggers on the falling edge of digital input DI1.
	-2 to -6	DI2 (INV) - DI6 (INV) – Reset loggers on the falling edge of digital input DI2 - DI6.
		Defines the source for the reset of peak value logger and amplitude logger 2.
	AL2 SIGNAL (6404)	Default: 103 (parameter 0103 OUTPUT FREQ) Range: 100 - 178
	100	NOT SELECTED – No signal (parameter) logged for amplitude distribution (amplitude logger 2).
	101 - 178	Logs parameter 0101 - 0178.
		Defines the signal logged for amplitude logger 2. • Any parameter number in Group: OPERATING DATA can be selected. Eg 102 = parameter 0102 SPEED.
	AL2 SIGNAL BASE (6405)	Default: Depends on the signal selected with par. 6404 Range:
		Defines the base value from which the percentage distribution is calculated. • Representation and default value depends on the signal selected with parameter 6404 AL2 SIGNAL.
	PEAK VALUE (6406)	Default: Range:
		Detected peak value of the signal selected with parameter 6401 PVL SIGNAL.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
LOAD ANALYZER (Continued)	**PEAK TIME 1** (6407)	Default: Range: Date dd.mm.yy / power-on time in days
		Date of the peak value detection. • Format: Date if the real time clock is operating (dd.mm.yy). / The number of days elapsed after the power-on if the real time clock is not used, or was not set (xx d).
	PEAK TIME 2 (6408)	Default: Range: Time hh.mm.ss
		Time of the peak value detection. • Format: hours:minutes:seconds.
	CURRENT AT PEAK (6409)	Default: Range: 0.0 - 6553.5 A
		Current at the moment of the peak value (amperes).
	UDC AT PEAK (6410)	Default: Range: 0 - 65535 V
		DC voltage at the moment of the peak value (volts).
	FREQ AT PEAK (6411)	Default: Range: 0.0 - 6553.5 Hz
		Output frequency at the moment of the peak value (hertz).
	TIME OF RESET 1 (6412)	Default: Range: Date dd.mm.yy / power-on time in days
		Last reset date of the peak logger and amplitude logger 2. • Format: Date if the real time clock is operating (dd.mm.yy). / The number of days elapsed after the power-on if the real time clock is not used, or was not set (xx d).
	TIME OF RESET 2 (6413)	Default: Range: Time hh.mm.ss
		Last reset time of the peak logger and amplitude logger 2. • Format: hours:minutes:seconds.
	AL1RANGE0TO10 (6414)	Default: Range: 0.0 - 100.0%
		Amplitude logger 1 (current in percent of nominal current I2N) 0 - 10% distribution.
	AL1RANGE10TO20 (6415)	Default: Range: 0.0 - 100.0%
		Amplitude logger 1 (current in percent of nominal current I2N) 10 - 20% distribution.
	AL1RANGE20TO30 (6416)	Default: Range: 0.0 - 100.0%
		Amplitude logger 1 (current in percent of nominal current I2N) 20 - 30% distribution.
	AL1RANGE30TO40 (6417)	Default: Range: 0.0 - 100.0%
		Amplitude logger 1 (current in percent of nominal current I2N) 30 - 40% distribution.
	AL1RANGE40TO50 (6418)	Default: Range: 0.0 - 100.0%
		Amplitude logger 1 (current in percent of nominal current I2N) 40 - 50% distribution.
	AL1RANGE50TO60 (6419)	Default: Range: 0.0 - 100.0%
		Amplitude logger 1 (current in percent of nominal current I2N) 50 - 60% distribution.
	AL1RANGE60TO70 (6420)	Default: Range: 0.0 - 100.0%
		Amplitude logger 1 (current in percent of nominal current I2N) 60 - 70% distribution.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
LOAD ANALYZER (Continued)	**AL1RANGE70TO80** (6421)	Default: Range: 0.0 - 100.0%
		Amplitude logger 1 (current in percent of nominal current I2N) 70 - 80% distribution.
	AL1RANGE80TO90 (6422)	Default: Range: 0.0 - 100.0%
		Amplitude logger 1 (current in percent of nominal current I2N) 80 - 90% distribution.
	AL1RANGE90TO (6423)	Default: Range: 0.0 - 100.0%
		Amplitude logger 1 (current in percent of nominal current I2N) over 90% distribution.
	AL2RANGE0TO10 (6424)	Default: Range: 0.0 - 100.0%
		Amplitude logger 2 (signal selection with parameter 6404) 0 - 10% distribution.
	AL2RANGE10TO20 (6425)	Default: Range: 0.0 - 100.0%
		Amplitude logger 2 (signal selection with parameter 6404) 10 - 20% distribution.
	AL2RANGE20TO30 (6426)	Default: Range: 0.0 - 100.0%
		Amplitude logger 2 (signal selection with parameter 6404) 20 - 30% distribution.
	AL2RANGE30TO40 (6427)	Default: Range: 0.0 - 100.0%
		Amplitude logger 2 (signal selection with parameter 6404) 30 - 40% distribution.
	AL2RANGE40TO50 (6428)	Default: Range: 0.0 - 100.0%
		Amplitude logger 2 (signal selection with parameter 6404) 40 - 50% distribution.
	AL2RANGE50TO60 (6429)	Default: Range: 0.0 - 100.0%
		Amplitude logger 2 (signal selection with parameter 6404) 50 - 60% distribution.
	AL2RANGE60TO70 (6430)	Default: Range: 0.0 - 100.0%
		Amplitude logger 2 (signal selection with parameter 6404) 60 - 70% distribution.
	AL2RANGE70TO80 (6431)	Default: Range: 0.0 - 100.0%
		Amplitude logger 2 (signal selection with parameter 6404) 70 - 80% distribution.
	AL2RANGE80TO90 (6432)	Default: Range: 0.0 - 100.0%
		Amplitude logger 2 (signal selection with parameter 6404) 80 - 90% distribution.
	AL2RANGE90TO (6433)	Default: Range: 0.0 - 100.0%
		Amplitude logger 2 (signal selection with parameter 6404) over 90% distribution.

Table 7-1 Parameter Definitions Continued

Group	Parameter (Number) Selection (Value)	Parameter Name and Description
OPTIONS	**COMM PROT SEL** (9802)	Default: 0 (NOT SEL) Range: 0, 1, 4
	0	NOT SEL – No communication protocol selected.
	1	STD MODBUS – The drive communicates with Modbus via the RS485 channel (X1-communications, terminal). • See also Group: EFB PROTOCOL.
	4	EXT FBA – The drive communicates via a fieldbus adapter module in option slot 2 of the drive. • See also Group: EXT COMM MODULE.
		Selects the communication protocol. **NOTE:** COMM PROT SEL (9802) can only be modified if the drive is stopped.

Chapter 8

Start-Up, Motor Model Calc & Customizing Your Application

This chapter contains information on how to perform the start-up; start, stop, change the direction of the motor rotation and adjust the speed of the motor through the I/O interface; and perform a motor model calculation on the drive.

The chapter also describes program features. For each feature, there is a list of related user settings, actual signals, and fault and alarm messages.

8.1 Starting up the drive

WARNING! The start-up may only be carried out by a qualified electrician. The safety instructions given in Chapter 1 must be followed during the start-up procedure.

WARNING! The drive will start up automatically at power-up if the external run command is on and the drive is in the remote control mode.

WARNING! Failure to correctly start up the motor may cause damage. De-couple the driven machine if:
- **there is a risk of damage in case of incorrect direction of rotation, or**
- **a motor model calc needs to be performed during the drive start-up. Motor model calc is essential only in applications that require the ultimate in motor control accuracy.**

The drive start up uses the assisant keypad.

The Start-up assistant, which is included in the assistant keypad only, guides you through all essential settings to be done. In the manual start-up, the drive gives no guidance; you go through the very basic settings by following the instructions given in section Performing a manual start-up below.

8.1.1 Starting up the drive without a keypad

POWER-UP

1. Apply input power and wait for a moment.
2. Check that the red LED is not lit and the green LED is lit but not blinking.

The drive is now ready for use.

8.1.2 Performing a manual start-up

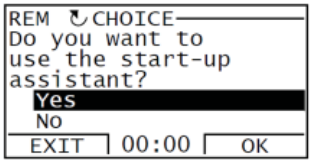
For the manual start-up, you can use the assistant keypad.

Before you start, ensure that you have obtained the motor nameplate data.

8.1.2.1 POWER-UP

☐ Apply input power.

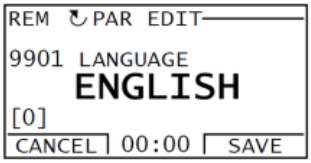
The assistant keypad asks if you want to run the Start-up assistant. If you press EXIT, the Start-up assistant is not run, and you can continue with the manual start-up procedure described below.



8.1.2.2 MANUAL ENTRY OF START-UP DATA (parameter group 99)

☐ On the assistant keypad, select the needed language from parameter 9901 for the values of the available language alternatives.

See Chapter 6 for assistance on editing parameters.



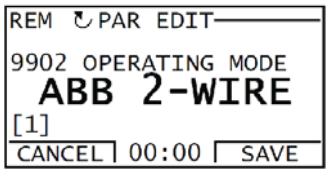
☐ Select the operating mode (parameter 9902) according to how the control cables are connected.

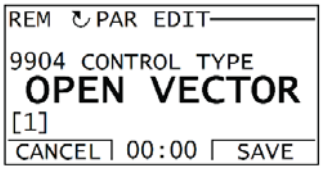
The default value ABB 2-wire is suitable in most cases.

☐ Select the control type (parameter 9904).

OPEN VECTOR: SPEED is suitable in most cases.
V/F: CONTROL is recommended

- for multimotor drives when the number of the motors connected to the drive is variable
- when the nominal motor current is less than 20% of the nominal current of the drive
- when the drive is used for test purposes with no motor connected.





☐ Enter the motor data from the motor nameplate.

Asynchronous motor nameplate example:

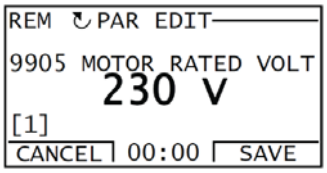
ABB Motors CE

3 ~ motor	M2AA 200 MLA 4						
	IEC 200 M/L 55						
		No					
		Ins.cl. F				IP 55	
V	Hz	kW	r/min	A	cos φ	IA/IN	tE/s
690 Y	50	30	1475	32.5	0.83		
400 D	50	30	1475	56	0.83		
660 Y	50	30	1470	34	0.83		
380 D	50	30	1470	59	0.83		
415 D	50	30	1475	54	0.83		
440 D	60	35	1770	59	0.83		
Cat. no	3GAA 202 001 - ADA						
6312/C3		6210/C3				180 kg	
				IEC 34-1			

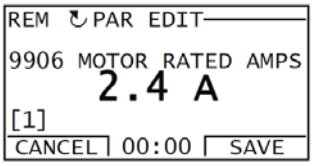
Note: Set the motor data to exactly the same value as on the motor nameplate.

For example, if the motor nominal speed is 1470 rpm on the nameplate, setting the value of parameter 9908 MOTOR NOM SPEED to 1500 rpm results in the wrong operation of the drive.

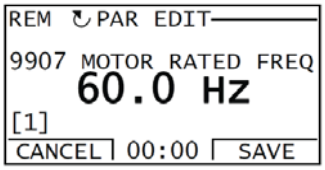
☐ Enter the motor data from the motor nameplate. (Continued)



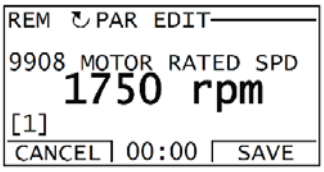
- motor rated voltage (parameter 9905).
  Use motor rated voltage and perform motor model calc.
  If the voltage is given as voltage per rpm, eg 60 V per 1000 rpm, the voltage for 3000 rpm nominal speed is 3 · 60 V = 180 V.



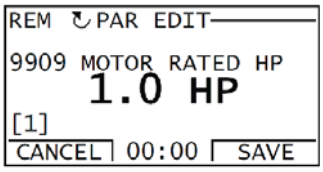
- motor rated amps (parameter 9906)
  Allowed range: 0.2…2.0 · I2N A



- motor rated frequency (parameter 9907)

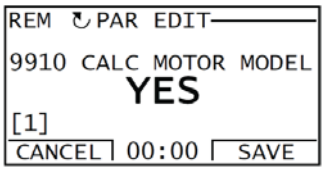


- motor rated speed (parameter 9908)



- motor rated hp (parameter 9909)

☐ Select the calc motor model method (parameter 9910)



The default value 0 using the identification magnetization is suitable for most applications. it is applied in this basic set-up procedure. Note that this requires parameter 9904 to be set to Vector: Speed.

If your selection is NO, move to the next step.

Value YES should be selected if:

- the operation point is near zero speed, and/or
- operation at torque range above the motor nominal torque over a wide speed range and without any measured speed feedback is required.

8.1.2.3 IDENTIFICATION MAGNETIZATION WITH MOTOR MODEL CALC SELECTION ON

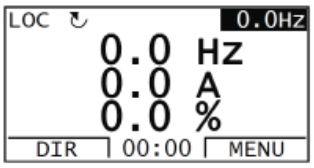
☐ Press LOC/REM to switch to local control (LOC shown on the left).

Press ◈ to start the drive. The motor model is now calculated by magnetizing the motor for 10 to 15 seconds at zero speed.

8.1.2.4 Direction of the motor Rotation

☐ Check the direction of the motor rotation.

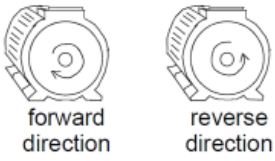
- If the drive is in remote control (REM shown on the left), switch to local control by pressing LOC/REM .

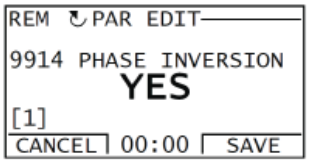


- Increase the frequency reference from zero to a small value with key ▲ .
- Press ◈ to start the motor.
- Check that the actual direction of the motor is the same as indicated on the display (FWD (forward) or REV (reverse)).
- Press ▽ to stop the motor.

To change the direction of the motor rotation:

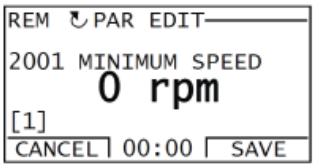
- Invert the phases by changing the value of parameter 9914 to the opposite (From 0 (NO) to 1 (YES) or vice versa)
- Verify your work by applying input power and repeating the check as described above.





8.1.2.5 Speed Limits and Acceleration/Deceleration Times

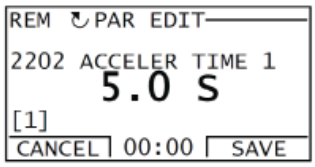
☐ Set the minimum speed (parameter 2001).



☐ Set the maximum speed (parameter 2002).

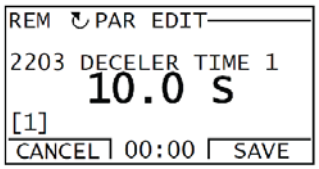
☐ Set the acceleration time 1 (parameter 2202).

NOTE: Acceleration time 2 (parameter 2205) must also be set if two acceleration times will be used in the application.



☐ Set the deceleration time 1 (parameter 2204).

NOTE: Deceleration time 2 (parameter 2205) must also be set if two deceleration times will be used in the application.



8.1.2.6 Saving a user mode and final check

☐ The start-up is now complete.

You can now set the parameters required by your application and save the settings as a user mode.

☐ Check that the drive state is OK.

Assistant Keypad: Check that there are not faults or alarms shown on the display.

1. Verify that the panel LED is green and does not blink.

THE DRIVE IS NOW READY FOR USE.

8.1.3 Performing a Guided Start-Up

To be able to perform the guided start-up, you need the assistant keypad. Guided start-up is applicable to AC induction motors.

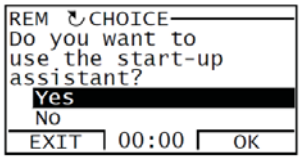
Before you start, ensure that you have the motor nameplate data on hand.

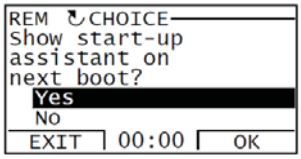
8.1.3.1 POWER-UP

☐ Apply input power. The keypad will ask if you want to use the Start-up assistant.

- Press OK (when YES is highlighted) to run the Start-up assistant.
- Press EXIT if you do not want to run the Start-up assistant.

- Press ▼ to highlight NO and then press OK to select if the panel asks you to run the Start-up assistant on next drive start up.





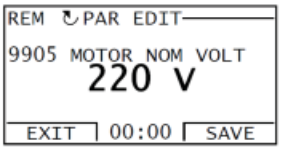
8.1.3.2 SELECTING THE LANGUAGE

☐ If you run the Start-up assistant, the display then asks you to select the language. Scroll to the desired language with keys ▲▼ and press SAVE to accept.

If you press EXIT, the Start-up assistant is stopped.

8.1.3.3 STARTING THE GUIDED SET-UP

☐ The Start-up assistant now guides you through the set-up tasks, starting with the motor set-up. Set the motor data to exactly the same value as on the motor nameplate.



Scroll to the desired parameter value with keys ▲▼ and press SAVE to accept and continue with the Start-up assistant.

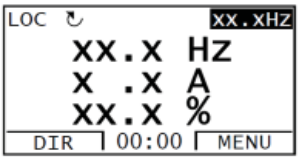
Note: At any time, if you press EXIT , the Start-up assistant is stopped and the display goes to the Output mode.

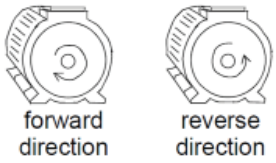
☐ The basic startup is now complete. To continue setup with another Assistant, please select the desired Assistant from the menu now showing on the keypad and press OK .

8.1.3.4 DIRECTION OF THE MOTOR ROTATION

☐ Press LOC to switch to local control (LOC shown on the left).

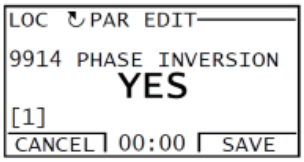
- If the drive is in remote control (REM shown on the status line), switch to local control by pressing LOC.
- If you are not in the Output mode, press EXIT repeatedly until you get there.
- Increase the frequency reference from zero to a small value with key ▲.
- Press ◈ to start the motor.
- Check that the actual direction of the motor is the same as indicated on the display (↻ means forward and ↺ reverse).
- Press ◈ to stop the motor.





To change the direction of the motor rotation:

- Invert the phases by changing the value of parameter 9914 to the opposite, ie from 0 (NO) to 1 (YES), or vice versa.
- Verify your work by applying input power and repeating the check as described above.



8.1.3.5 FINAL CHECK

☐ After the whole set-up is completed, check that there are no faults or alarms shown on the display and the panel LED is green and does not blink.

THE DRIVE IS NOW READY FOR USE.

8.2 Controlling the Drive through the I/O Interface

This section gives instructions on how to operate the drive through the digital and analog inputs when:

- the motor start-up is performed, and
- the default (standard) parameter settings are valid.

Displays of the basic keypad are shown as an example.

8.2.1 PRELIMINARY SETTINGS

If you need to change the direction of rotation, check that parameter 1003 DIRECTION is set to 3 (REQUEST).

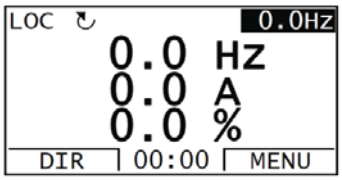
Ensure that the control connections are wired according to the connection diagram given for standard mode.

In remote control, the panel display shows text REM.

Ensure that the drive is in remote control. Press key LOC to switch between remote and local control.

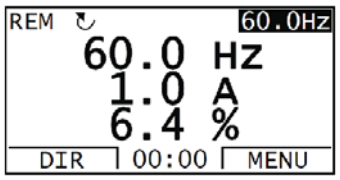
8.2.2 STARTING AND CONTROLLING THE SPEED OF THE MOTOR

Start by switching digital input DI1 to ON.



Assistant Keypad: The arrow starts rotating. It is dotted until the setpoint is reached.

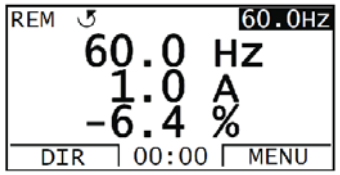
Basic Control Panel: Text FWD starts flashing fast and stops after the setpoint is reached.



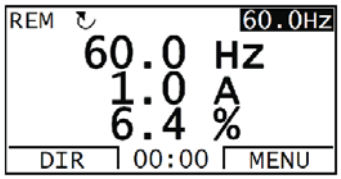
Regulate the drive output frequency (motor speed) by adjusting the voltage of analog input AI1.

8.2.3 CHANGING THE DIRECTION OF THE MOTOR ROTATION

Reverse direction: Switch digital input DI2 on.

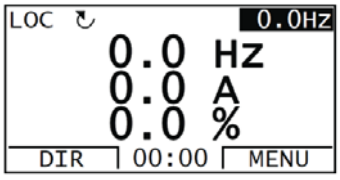


Forward direction: Switch digital input DI2 off.



8.2.4 STOPPING THE MOTOR

Switch digital input DI1 off. The motor stops.



Assistant keypad: The arrow stops rotating.

Basic Control Panel: Text FWD starts flashing slowly.

8.3 Performing Motor Model Calc

The drive estimates motor characteristics automatically when the drive is started for the first time and after any motor parameter (group 99 START-UP DATA) is changed.
This is valid when parameter 9910 Motor model calc has value NO.

In most applications there is no need to perform a Calc Motor Model. Should be set to YES if:

- vector control mode is used (parameter 9904 = OPEN VECTOR
- operation point is near zero speed and/or
- permanent magnet synchronous motor is used and the back emf voltage is unknown.

Note: If motor parameters (group: START-UP DATA) are changed after the motor model calc, it must be repeated.

8.3.1 Motor Model Calc

The general parameter setting procedure is not repeated here. The motor model calc cannot be performed without a keypad.

8.3.1.1 PRE-CHECK

WARNING! The motor will run at up to approximately 50 - 80% of the nominal speed during the motor model calc. The motor will rotate in the forward direction. Ensure that it is safe to run the motor before performing the motor model calc!

☐ De-couple the motor from the driven equipment.

☐ If parameter values (group: OPERATING DATA to group: OPTIONS) are changed before the motor model calc, check that the new settings meet the following conditions:

☐ • 2001 MINIMUM SPEED < 0 rpm

☐ • 2002 MAXIMUM SPEED > 80% of the motor rated speed

☐ • 2003 MAX CURRENT > I_{2N}

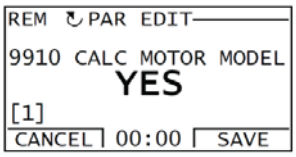
☐ • 2017 MAX TORQUE 1 > 50%

☐ Check that the Run enable signal is on (parameter 1601).

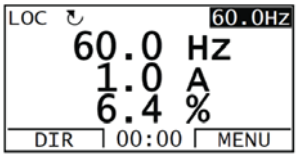
☐ Ensure that the panel is in local control (LOC shown at the top). Press key LOC/REM to switch between local and remote control.

8.3.1.2 MOTOR MODEL CALC WITH THE ASSISTANT KEYPAD

☐ Change parameter 9910 Calc Motor Model YES. Save the new setting by pressing SAVE.

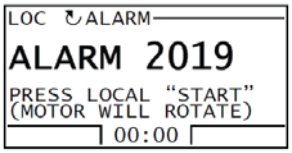


☐ If you want to monitor actual values during the Motor Model Calc, go to the Output mode by pressing EXIT repeatedly until you get there.



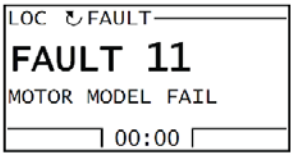
☐ Press START to start the Motor Model Calc. The panel keeps switching between the display that was shown when you started the Motor Model Calc and the alarm display presented on the right.

In general, it is recommended not to press any keypad keys during the Motor Model Calc. However, you can stop the Motor Model Calc at any time by pressing STOP.



☐ After the Motor Model Calc is completed, the alarm display is not shown any more.

If the Motor Model Calc fails, the fault display presented on the right is shown.



8.4 Program features

The section describes program features. For each feature, there is a list of related user settings, actual signals, and fault and alarm messages.

8.4.1 Start-up assistant

8.4.1.1 Introduction

The Start-up assistant (requires the assistant keypad) guides the user through the start-up procedure, helping to enter the requested data (parameter values) to the drive. The Start-up assistant also checks that the entered values are valid, ie within the allowed range.

The Start-up assistant calls other assistants, each of which guides the user through the task of specifying a related parameter set. At the first start, the drive suggests entering the first task, Language select, automatically. The user may activate the tasks either one after the other as the Start-up assistant suggests, or independently. The user may also adjust the drive parameters in the conventional way without using the assistant at all.

See the section on Assistants mode for information on how to start the Start-up assistant or other assistants.

8.4.1.2 Default order of the tasks

Depending on the selection made in the Application task (parameter 9902 OPERATING MODE, the Start-up assistant decides which consequent tasks it suggests. The default tasks are shown in the table below.

Table 8-1 Default Order of Tasks

Application selection	Default tasks
ABB 2-WIRE	Language select, Motor set-up, Application, Option modules, Speed control EXT1, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals
ABB 3-WIRE	Language select, Motor set-up, Application, Option modules, Speed control EXT1, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals
BALDOR 2-WIRE	Language select, Motor set-up, Application, Option modules, Speed control EXT1, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals
MOTOR POT	Language select, Motor set-up, Application, Option modules, Speed control EXT1, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals
HAND/AUTO	Language select, Motor set-up, Application, Option modules, Speed control EXT1, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals
PID CONTROL	Language select, Motor set-up, Application, Option modules, PID control, Speed control EXT2, Start/Stop control, Timed functions, Protections, Output signals

8.4.1.3 List of the tasks and the relevant drive parameters

Depending on the selection made in the Application task (parameter 9902 OPERATING MODE), the Start-up assistant decides which consequent tasks it suggests.

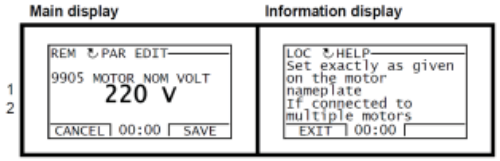
Table 8-2 Tasks and Relevant Drive Parameters

Name	Description	Set parameters
Language select	Selecting the language.	9901
Motor set-up	Setting the motor data Performing the motor identification (If the speed limits are not in the allowed range: Setting the limits.)	9904…9909 9910
Application	Selecting the application macro	9902, parameters associated to the macro
Option modules	Activating the option modules	Group 35 MOTOR TEMP MEAS, Group 52 PANEL COMM, 9802
Speed control EXT1	Selecting the source for the speed reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits Setting the speed (frequency) limits Setting the acceleration and deceleration times	1103 (1301…1303, 3001) 1104, 1105 2001, 2002 (2007, 2008) 2202, 2203

Speed control EXT2	Selecting the source for the speed reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits	1106 (1301…1303, 3001) 1107, 1108
PID control	Selecting the source for the process reference (If AI1 is used: Setting analog input AI1 limits, scale, inversion) Setting the reference limits Setting the speed (frequency) limits Setting the source and limits for the process actual value	1106 (1301…1303, 3001) 1107, 1108 2001, 2002 (2007, 2008) 4016, 4018, 4019
Start/Stop control	Selecting the source for start and stop signals of the two external control locations, EXT1 and EXT2 Selecting between EXT1 and EXT2 Defining the direction control Defining the start and stop modes Selecting the use of Run enable signal	1001, 1002 1102 1003 2101…2103 1601
Protections	Setting the current and torque limits	2003, 2017
Output signals	Selecting the signals indicated through relay output RO1 and, if MREL-01 output relay module is in use, RO2…RO4. Selecting the signals indicated through analog output AO Setting the minimum, maximum, scaling and inversion	Group 14 RELAY OUTPUTS Group 15 ANALOG OUTPUTS

8.4.1.4 Contents of the assistant displays

There are two types of displays in the Start-up assistant: Main displays and information displays. The main displays prompt the user to feed in information. The assistant steps through the main displays. The information displays contain help texts for the main displays. The figure below shows a typical example of both and explanations of the contents.



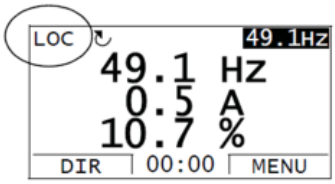
1 2	Parameter Feed-in field	Help text ... ... help text continued

8.5 Local control vs. external control

The drive can receive start, stop and direction commands and reference values from the keypad or through digital and analog inputs. Embedded fieldbus or an optional fieldbus adapter enables control over an open fieldbus link. A PC equipped with the DriveWindow Light 2 PC tool can also control the drive.

8.5.1 Local control

The control commands are given from the keypad keypad when the drive is in local control. LOC indicates local control on the panel display.

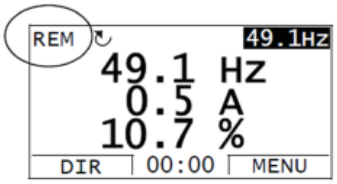


The keypad always overrides the external control signal sources when used in local control.

8.5.2 External control

When the drive is in external (remote) control, the commands are given through the standard I/O terminals (digital and analog inputs) and/or the fieldbus interface. In addition, it is also possible to set the keypad as the source for the external control.

External control is indicated with REM on the panel display.



The user can connect the control signals to two external control locations, EXT1 or EXT2. Depending on the user selection, either one is active at a time.

8.5.3 Settings

Panel Key	Additional Information
LOC/REM	Selection between local and external (remote control)
Parameter	
1102	Selection between EXT1 and EXT2
1001/1002	Start, stop, direction source for EXT1/EXT2
1103/1106	Reference source for EXT1/EXT2

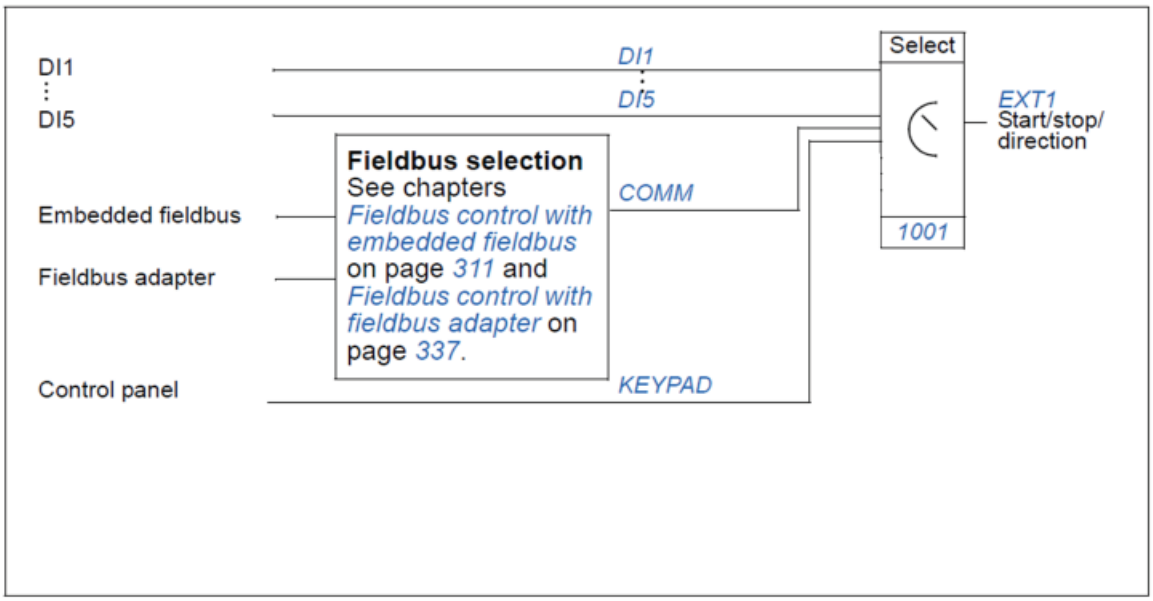
8.5.4 Diagnostics

Actual Signal	Additional Information
0111/0112	EXT1/EXT2 reference

8.5.5 Block diagram: Start, stop, direction source for EXT1

The figure below shows the parameters that select the interface for start, stop, and direction for external control location EXT1.

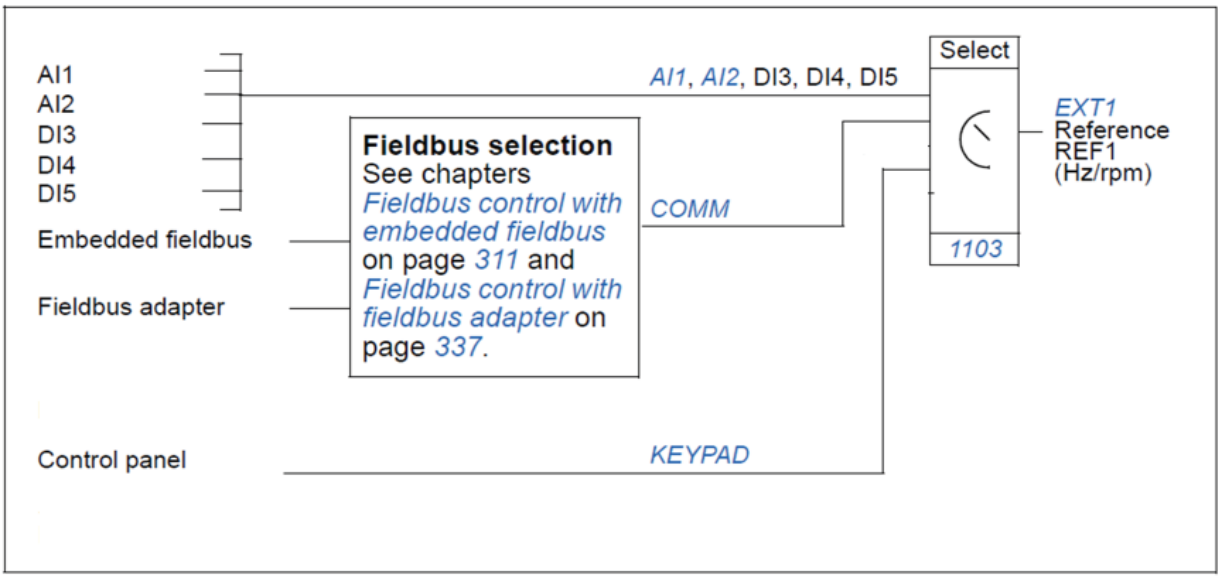
Figure 8-1 Start, Stop, Direction source for EXT1



8.5.6 Block diagram: Reference source for EXT1

The figure below shows the parameters that select the interface for the speed reference of external control location EXT1.

Figure 8-2 Reference Source for EXT1



8.6 Reference types and processing

The drive can accept a variety of references in addition to the conventional analog input and keypad signals.

- The drive reference can be given with two digital inputs: One digital input increases the speed, the other decreases it.
- The drive can form a reference out of two analog input signals by using mathematical functions: addition, subtraction, multiplication and division.
- The drive can form a reference out of an analog input signal and a signal received through a serial communication interface by using mathematical functions: addition and multiplication.
- The drive reference can be given with frequency input.
- In external control location EXT1/2, the drive can form a reference out of an analog input signal and a signal received through Sequence programming by using a mathematical function: addition.

It is possible to scale the external reference so that the signal minimum and maximum values correspond to a speed other than the minimum and maximum speed limits.

8.6.1 Settings

Parameter	Additional information
Group 11 REFERENCE SELECT	External reference source, type and scaling
Group 20 LIMITS	Operating limits
Group 22 ACCEL/DECEL	Speed reference acceleration/deceleration ramps
Group 24 TORQUE CONTROL	Torque reference ramp times
Group 32 SUPERVISION	Reference supervision

8.6.2 Diagnostics

Actual signal	Additional information
0111/0112	REF1/REF2 reference
Group 03 FB ACTUAL SIGNALS	References in different stages of the reference processing chain

8.7 Programmable analog inputs

The drive has two programmable analog voltage/current inputs. The inputs can be inverted, filtered and the maximum and minimum values can be adjusted.

8.7.1 Settings

Parameter	Additional information
Group 11 REFERENCE SELECT	REF1/2 selection
Group 13 ANALOG INPUTS	Trimming function settings
3001, 3021, 3022, 3107	AI loss supervision
Group 35 MOTOR TEMP MEAS	AI in motor temperature measurement
Groups 40 PROCESS PID SET 1 …42 EXT / TRIM PID	AI as PID process control reference or actual value source

8.7.2 Diagnostics

Actual signal	Additional information
0120, 0121	Analog input values
1401	AI1/AI2 signal loss through RO 1
1402/1403/1410	AI1/AI2 signal loss through RO 2…4. With option
Alarm	
AI1 LOSS / AI2 LOSS	AI1/AI2 signal below limit 3021 AI1 FAULT LIMIT / 3022 AI2 FAULT LIMIT
Fault	
AI1 LOSS / AI2 LOSS	AI1/AI2 signal below limit 3021 AI1 FAULT LIMIT / 3022 AI2 FAULT LIMIT
PAR AI SCALE	Incorrect AI signal scaling (1302 < 1301 or 1305 < 1304)

8.8 Programmable analog output

Two programmable current outputs (0 (4)…20 mA) are available. Analog output signal can be inverted, filtered and the maximum and minimum values can be adjusted. The analog output signals can be proportional to motor speed, output frequency, output current, motor torque, motor power, etc.

8.8.1 Settings

Parameter	Additional information
Group 15 ANALOG OUTPUTS	AO value selection and processing
Group 35 MOTOR TEMP MEAS	AO in motor temperature measurement

8.8.2 Diagnostics

Actual signal	Additional information
0124	AO 1 value
0125	AO 2 value
Fault	
PAR AO SCALE	Incorrect AO signal scaling (1505L1504 or 1511L1510)

8.9 Programmable digital inputs

The drive has six programmable digital inputs. The update time for the digital inputs is 2 ms.
One digital input (DI5) can be programmed as a frequency input.

8.9.1 Settings

Parameter	Additional information
Group 10	START/STOP/DIR DI as start, stop, direction
Group 11	REFERENCE SELECT DI in reference selection, or reference source
Group 12 CONSTANT SPEEDS	DI in constant speed selection
Group 16 SYSTEM CONTROLS	DI as external Run enable, fault reset or user mode change signal
2109	DI as external emergency stop command source
2201	DI as acceleration and deceleration ramp selection signal
2209	DI as zero ramp force signal
3003 / 3004	DI as external fault source
Group 35 MOTOR TEMP MEAS	DI in motor temperature measurement
4010	DI as PID controller reference signal source
4022	DI as sleep function activation signal in PID1

8.10 Programmable relay output

The drive has three programmable relay outputs. With a parameter setting it is possible to choose what information to indicate through the relay output: Ready, running, fault, alarm, etc.

A value can be written to a relay output through a serial communication link.

8.10.1 Settings

Parameter	Additional information
Group 14 RELAY OUTPUTS	RO value selections and operation times

8.10.2 Diagnostics

Actual signal	Additional information
0134	RO Control word through fieldbus control

8.11 Actual signals

Several actual signals are available:
- Drive output frequency, current, voltage and power
- Motor speed and torque
- Intermediate circuit DC voltage
- Active control location (LOCAL, EXT1 or EXT2)
- Reference values
- Drive temperature
- Operating time counter (h), kWh counter
- Digital I/O and analog I/O status
- PID controller actual values

Three signals can be shown simultaneously on the assistant keypad display (one signal on the basic keypad display). It is also possible to read the values through the serial communication link or through the analog outputs.

8.11.1 Settings

Parameter	Additional information
1501	Selection of an actual signal to AO
1808	Selection of an actual signal to frequency output
Group 32 SUPERVISION	Actual signal supervision
Group 34 PANEL DISPLAY	Selection of an actual signals to be displayed on the control pane

8.11.2 Diagnostics

Actual Signal	Additional information
Groups 01 OPERATING DATA … 04 FAULT HISTORY	Lists of actual signals

8.12 Motor identification

The performance of vector control is based on an accurate motor model determined during the motor start-up.

A motor Identification magnetization is automatically performed the first time the start command is given. During this first start-up, the motor is magnetized at zero speed for several seconds to allow the motor model to be created. This identification method is suitable for most applications.

In demanding applications a separate Motor Control Calculation can be performed.

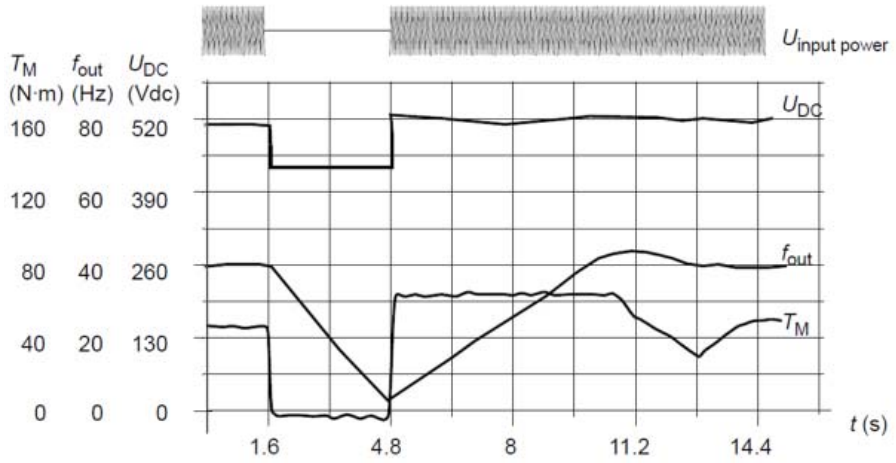
8.12.1 Settings

Parameter 9910 Motor Control Calculation

8.13 Power loss ride-through

If the incoming supply voltage is cut off, the drive will continue to operate by utilizing the kinetic energy of the rotating motor. The drive will be fully operational as long as the motor rotates and generates energy to the drive. The drive can continue the operation after the break if the main contactor remained closed.

Figure 8-1 Power Loss Ride-Through



UDC = Intermediate circuit voltage of the drive, fout = Output frequency of the drive, TM = Motor torque

Loss of supply voltage at nominal load (fout = 40 Hz). The intermediate circuit DC voltage drops to the minimum limit. The controller keeps the voltage steady as long as the input power is switched off. The drive runs the motor in generator mode. The motor speed falls but the drive is operational as long as the motor has enough kinetic energy.

8.13.1 Settings

Parameter 2006 UNDERVOLT CTRL

8.14 DC magnetizing

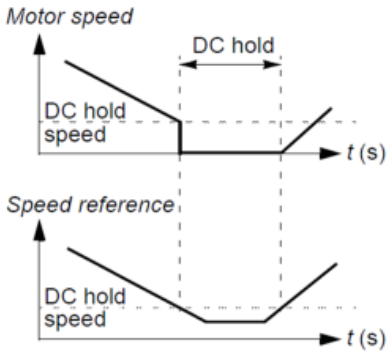
When DC magnetizing is activated, the drive automatically magnetizes the motor before starting. This feature guarantees the highest possible break-away torque, up to 180% of the motor nominal torque. By adjusting the premagnetizing time, it is possible to synchronize the motor start and eg a mechanical brake release. The Automatic start feature and DC magnetizing cannot be activated at the same time.

8.14.1 Settings

Parameters 2101 START FUNCTION and 2103 DC MAGN TIME

8.15 DC hold

With the motor DC hold feature, it is possible to lock the rotor at zero speed. When both the reference and the motor speed fall below the preset DC hold speed, the drive stops the motor and starts to inject DC into the motor. When the reference speed again exceeds the DC hold speed, the normal drive operation resumes.



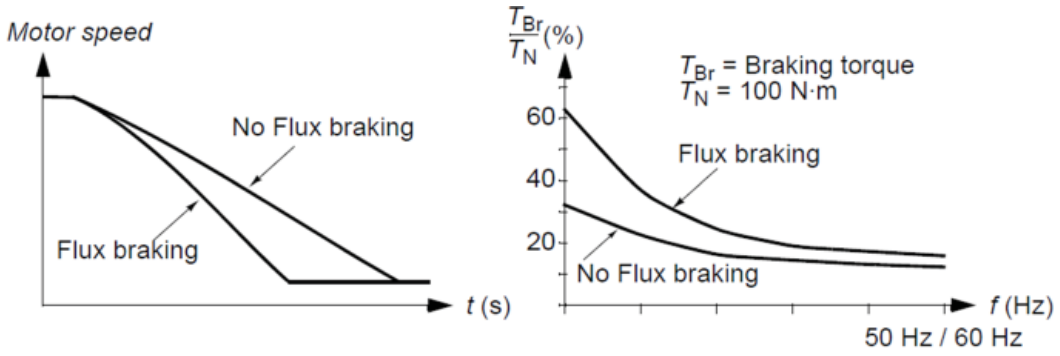
8.15.1 Settings

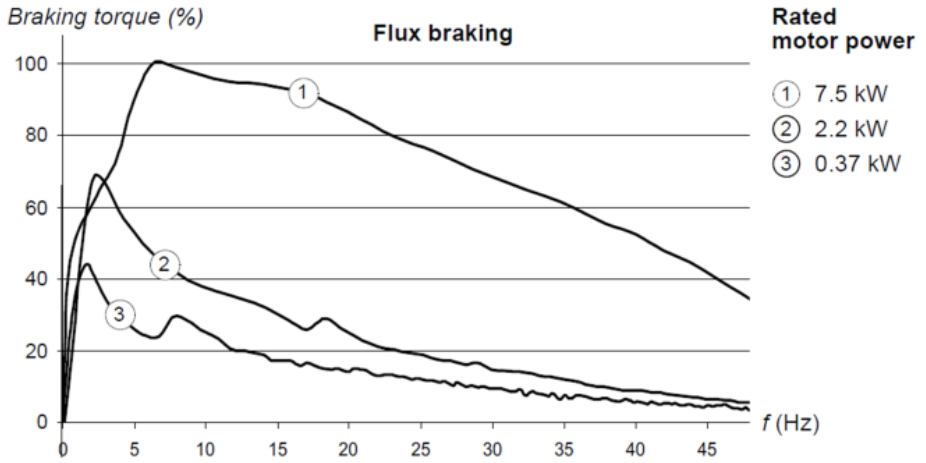
Parameters 2101…2106

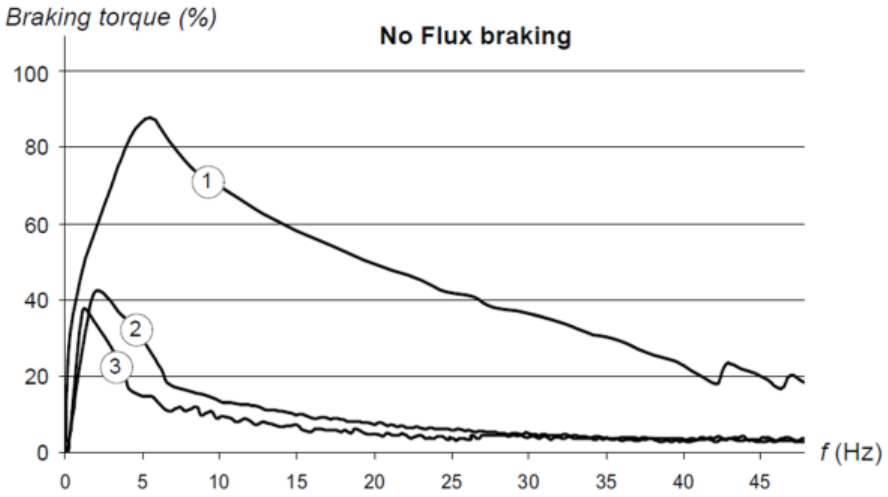
8.16 Flux braking

The drive can provide greater deceleration by raising the level of magnetization in the motor. By increasing the motor flux, the energy generated by the motor during braking can be converted to motor thermal energy.

Figure 8-1 Flux Braking Charts







The drive monitors the motor status continuously, also during the Flux braking. Therefore, Flux braking can be used both for stopping the motor and for changing the speed. The other benefits of Flux braking are:
- The braking starts immediately after a stop command is given. The function does not need to wait for the flux reduction before it can start the braking.
- The cooling of the motor is efficient. The stator current of the motor increases during the Flux braking, not the rotor current. The stator cools much more efficiently than the rotor.

8.16.1 Settings

Parameter 2602 FLUX BRAKING

8.17 Flux optimization

Flux optimization reduces the total energy consumption and motor noise level when the drive operates below the nominal load. The total efficiency (motor and the drive) can be improved by 1% to 10%, depending on the load torque and speed.

8.17.1 Settings

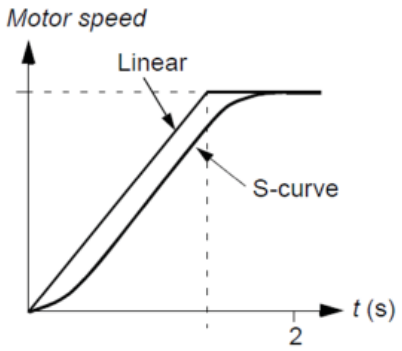
Parameter 2601 FLUX OPT ENABLE

8.18 Acceleration and deceleration ramps

Two user-selectable acceleration and deceleration ramps are available. It is possible to adjust the acceleration/deceleration times and the ramp shape. Switching between the two ramps can be controlled through a digital input or fieldbus.

The available ramp shape alternatives are Linear and S-curve.

Linear shape is suitable for drives requiring steady or slow acceleration/deceleration.



S-curve shape is ideal for conveyors carrying fragile loads, or other applications where a smooth transition is required when changing the speed.

8.18.1 Settings

Parameter group 22 ACCEL/DECEL

Sequence programming offers eight additional ramp times. See section on Sequence programming.

8.19 Critical speeds

Critical speeds function is available for applications where it is necessary to avoid certain motor speeds or speed bands because of eg mechanical resonance problems. The user can define three critical speeds or speed bands.

8.19.1 Settings

Parameter group 25 CRITICAL SPEEDS

8.20 Constant speeds

It is possible to define seven positive constant speeds. Constant speeds are selected with digital inputs. Constant speed activation overrides the external speed reference. Constant speed selections are ignored if:
- torque control is active, or
- PID reference is being followed, or
- drive is in local control mode.

This function operates on a 2 ms time level.

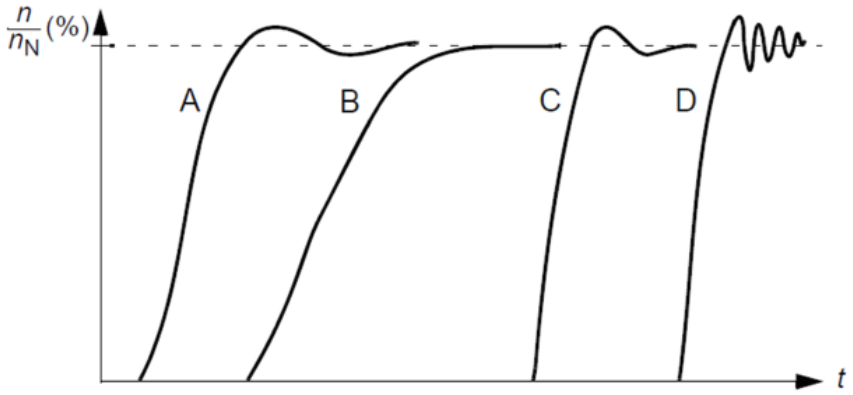
8.20.1 Settings

Parameter	Additional information
Group 12 CONSTANT SPEEDS	Constant speed settings
1208	Constant speed 7. Used also for fault functions (see group 30 FAULT FUNCTIONS) and for jogging function.

8.21 Speed controller tuning

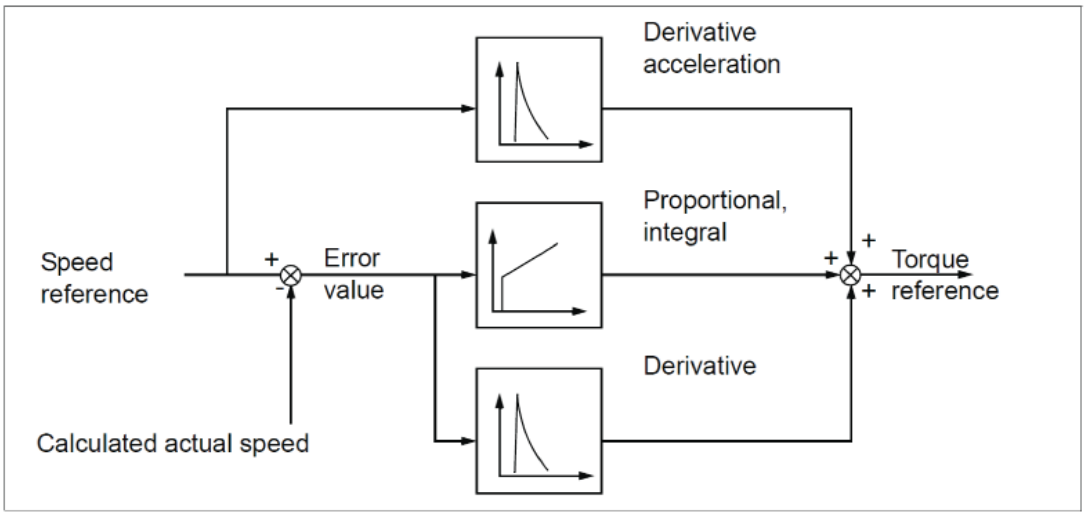
It is possible to manually adjust the controller gain, integration time and derivation time, or let the drive perform a separate speed controller Autotune run (parameter 2305 AUTOTUNE RUN). In Autotune run, the speed controller is tuned based on the load and inertia of the motor and the machine. The figure below shows speed responses at a speed reference step (typically, 1 to 20%).

Figure 8-2 Speed Controller Tuning



A: Undercompensated
B: Normally tuned (autotuning)
C: Normally tuned (manually). Better dynamic performance than with B

The figure below is a simplified block diagram of the speed controller. The controller output is the reference for the torque controller.



NOTE: The speed controller can be used in vector control, ie when 9904 MOTOR CTRL MODE setting is VECTOR: SPEED or VECTOR: TORQ.

8.21.1 Settings

Parameter groups 23 SPEED CONTROL and 20 LIMITS

8.21.2 Diagnostics

Actual signal 0102 SPEED

8.22 V/F control

It is possible to select V/F control as the motor control method instead of vector control. In the V/F control mode, the drive is controlled with a frequency reference.

It is recommended to activate the V/F control mode in the following special applications:

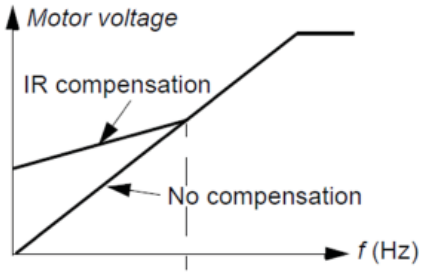
- In multimotor drives: 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after the motor identification.
- If the nominal motor current is less than 20% of the nominal output current of the drive.
- When the drive is used for test purposes with no motor connected.

The V/F control mode is not recommended for permanent magnet synchronous motors.

In the V/F control mode, some standard features are not available.

8.22.1 Settings

Parameter 9904 CONTROL TYPE

IR compensation for a scalar controlled drive IR compensation is active only when the motor control mode is V/F. When IR compensation is activated, the drive gives an extra voltage boost to the motor at low speeds. IR compensation is useful in applications that require high breakaway torque. In vector control, no IR compensation is possible/needed.	

Parameter 2603 IR COMP VOLT

8.23 Programmable protection functions

8.23.1 AI<Min

AI<Min function defines the drive operation if an analog input signal falls below the set minimum limit.

8.23.2 Settings

Parameters 3001 AI<MIN FUNCTION, 3021 AI1 FAULT LIMIT and 3022 AI2 FAULT LIMIT

8.23.3 Panel loss

Panel loss function defines the operation of the drive if the keypad selected as the control location for the drive stops communicating.

8.23.3.1 Settings

Parameter 3002 PANEL COMM ERR

8.23.4 External fault

External faults (1 and 2) can be supervised by defining one digital input as a source for an external fault indication signal.

8.23.4.1 Settings

Parameters 3003 EXTERNAL FAULT 1 and 3004 EXTERNAL FAULT 2

8.23.5 Stall protection

The drive protects the motor in a stall situation. It is possible to adjust the supervision limits (frequency, time) and choose how the drive reacts to the motor stall condition (alarm indication / fault indication & drive stop / no reaction).

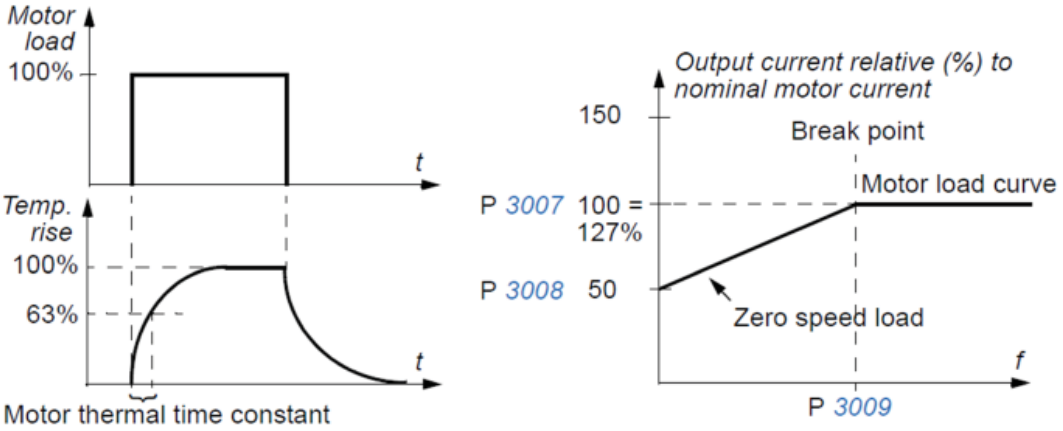
8.23.5.1 Settings

Parameters 3010 STALL FUNCTION, 3011 STALL FREQUENCY and 3012 STALL TIME

8.23.6 Motor thermal protection

The motor can be protected against overheating by activating the Motor thermal protection function.

The drive calculates the temperature of the motor on the basis of the following assumptions:
- The motor is in the ambient temperature of 30 °C (86°F) when power is applied to the drive.
- Motor temperature is calculated using either the user-adjustable or automatically calculated motor thermal time constant and motor load curve (see the figures below). The load curve should be adjusted if the ambient temperature exceeds 30 °C (86°F).



8.23.6.1 Settings

Parameters 3005 MOT THERM PROT, 3006 MOT THERM TIME, 3007 MOT LOAD CURVE, 3008 ZERO SPEED LOAD and 3009 BREAK POINT FREQ

NOTE: It is also possible to use the motor temperature measurement function. See section Motor temperature measurement through the standard I/O on page 160.

8.23.6.1 Settings

Parameters 3013 UNDERLOAD FUNC, 3014 UNDERLOAD TIME and 3015 UNDERLOAD CURVE

8.23.7 Earth fault protection

The Earth fault protection detects earth faults in the motor or motor cable. The protection can be selected to be active during start and run or during start only.

An earth fault in the input power line does not activate the protection.

8.23.7.1 Settings

Parameter 3017 EARTH FAULT

8.23.8 Incorrect wiring

Defines the operation when incorrect input power cable connection is detected.

8.23.8.1 Settings

Parameter 3023 WIRING FAULT

8.24 Pre-programmed faults

8.24.1 Overcurrent

The overcurrent trip limit for the drive is 325% of the drive nominal current.

8.24.2 DC overvoltage

The DC overvoltage trip limit is 420 V (for 200 V drives) and 840 V (for 400 V drives).

8.24.3 DC undervoltage

The DC undervoltage trip limit is adaptive. See parameter 2006 UNDERVOLT CTRL.

8.24.4 Drive temperature

The drive supervises the IGBT temperature. There are two supervision limits: Alarm limit and fault trip limit.

8.24.5 Short-circuit

If a short-circuit occurs, the drive will not start and a fault indication is given.

8.24.6 Internal fault

If the drive detects an internal fault, the drive is stopped and a fault indication is given.

8.25 Operation limits

The drive has adjustable limits for speed, current (maximum), torque (maximum) and DC voltage.

8.25.1 Settings

Parameter group 20 LIMITS

8.26 Power limit

Power limitation is used to protect the input bridge and the DC intermediate circuit. If the maximum allowed power is exceeded, the drive torque is automatically limited. Maximum overload and continuous power limits depend on the drive hardware.

For specific values, see Technical data.

8.27 Automatic resets

The drive can automatically reset itself after overcurrent, overvoltage, undervoltage, external and “analog input below a minimum” faults. The Automatic resets must be activated by the user.

8.27.1 Settings

Parameter	Additional information
Group 31 AUTOMATIC RESET	Automatic reset settings

8.27.2 Diagnostics

Alarm	Additional information
AUTORESET	Automatic reset alarm

8.28 Supervisions

The drive monitors whether certain user selectable variables are within the user defined limits. The user may set limits for speed, current etc. The supervision status can be indicated through relay or digital output.

The supervision functions operate on a 2 ms time level.

8.28.1 Settings

Parameter group 32 SUPERVISION

8.28.2 Diagnostics

Actual signal	Additional information
1401	Supervision status through RO 1
1402/1403/1410	Supervision status through RO 2…4. With option MREL-01 only.
1805	Supervision status through DO
8425, 8426 / 8435, 8436 /…/8495, 8496	Sequence programming state change according to supervision functions

8.29 Parameter lock

The user can prevent parameter adjustment by activating the parameter lock.

8.29.1 Settings

Parameters 1602 PARAMETER LOCK and 1603 PASS CODE

8.30 PID control

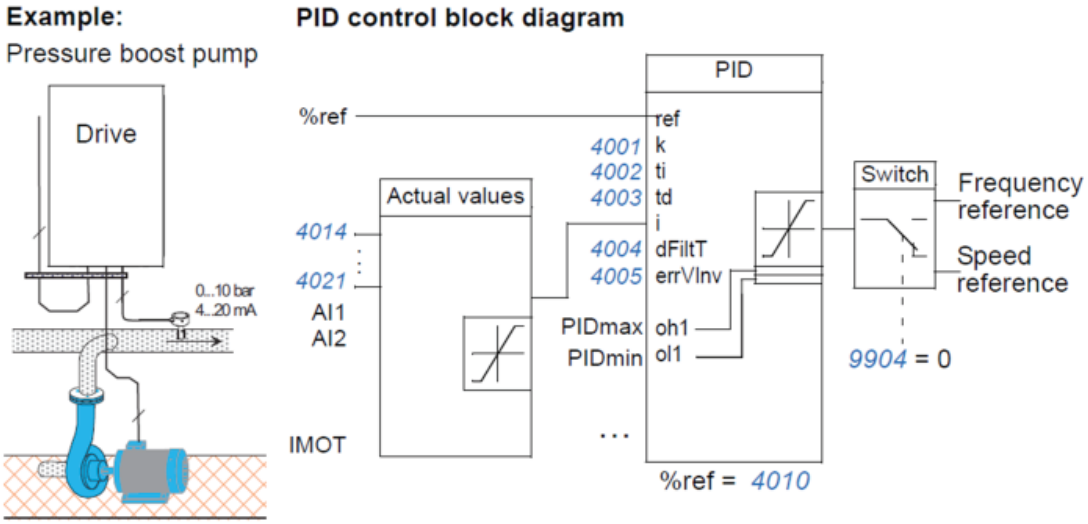
There is one built-in PID controller in the drive:
- Process PID (PID1)

The PID controller can be used when the motor speed needs to be controlled based on process variables such as pressure, flow or temperature.

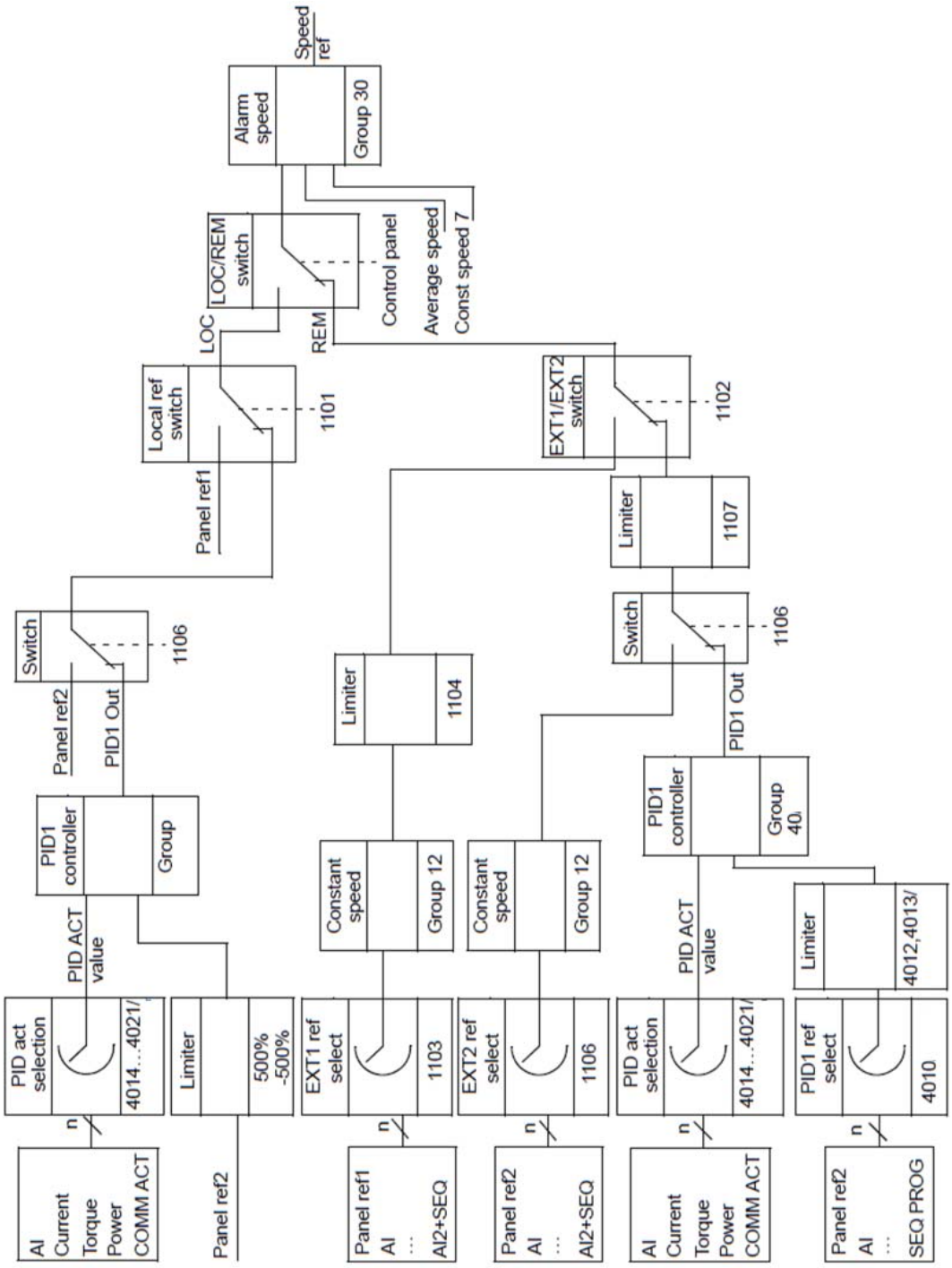
When the PID control is activated, a process reference (setpoint) is connected to the drive instead of a speed reference. An actual value (process feedback) is also brought back to the drive. The drive compares the reference and the actual values, and automatically adjusts the drive speed in order to keep the measured process quantity (actual value) at the desired level (reference).

8.30.1 Block diagrams

The figure below shows an application example: The controller adjusts the speed of a pressure boost pump according to the measured pressure and the set pressure reference.



The following figure presents the speed/scalar control block diagram for process controller PID1.



8.30.2 Settings

Parameter	Additional information
1101	Local control mode reference type selection
1102	EXT1/EXT2 selection
1106	PID1 activation
1107	REF2 minimum limit
1501	PID2 output (external controller) connection to AO
9902	PID control macro selection
Groups 40 PROCESS PID SET 1…	PID1 settings

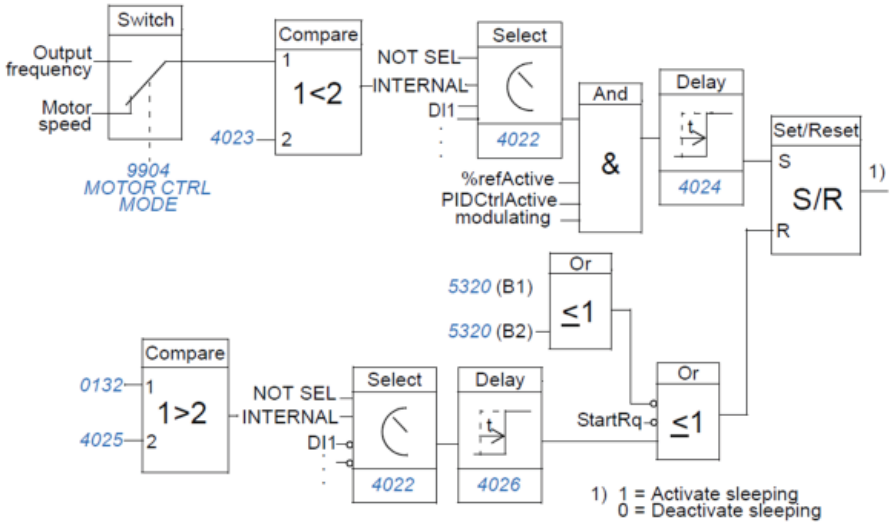
8.30.3 Diagnostics

Actual signal	Additional information
0126	PID 1 output value
0128	PID 1 setpoint value
0130	PID 1 feedback value
0132	PID 1 deviation

8.31 Sleep function for the process PID (PID1) control

The sleep function operates on a 2 ms time level.

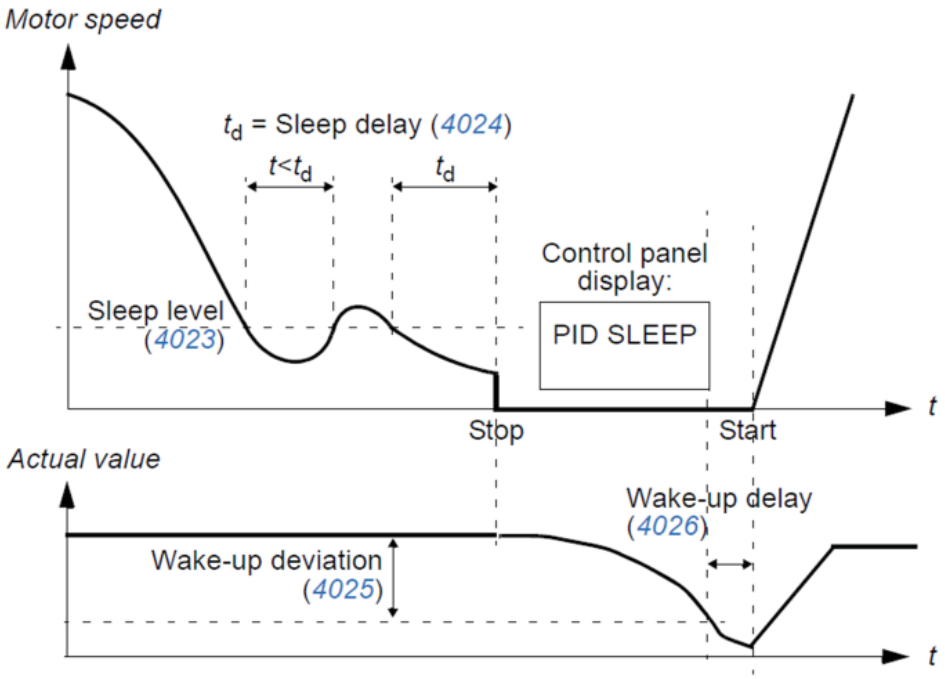
The block diagram below illustrates the sleep function enable/disable logic. The sleep function can be put into use only when the PID control is active.



Motor speed: Actual speed of the motor
%refActive: The % reference (EXT REF2) is in use. See parameter *1102 EXT1/EXT2 SEL*.
PIDCtrlActive: Parameter *9902 APPLIC MACRO* = *PID CONTROL*.
modulating: Drive IGBT control is operating.

8.31.1 Example

The time scheme below visualizes the operation of the sleep function.



Sleep function for a PID controlled pressure boost pump (when parameter 4022 SLEEP SELECTION is set to INTERNAL): The water consumption falls at night. As a consequence, the PID process controller decreases the motor speed. However, due to natural losses in the pipes and the low efficiency of the centrifugal pump at low speeds, the motor does not stop but keeps rotating. The sleep function detects the slow rotation, and stops the unnecessary pumping after the sleep delay has passed.
The drive shifts into sleep mode, still monitoring the pressure. The pumping restarts when the pressure falls under the allowed minimum level and the wake-up delay has passed.

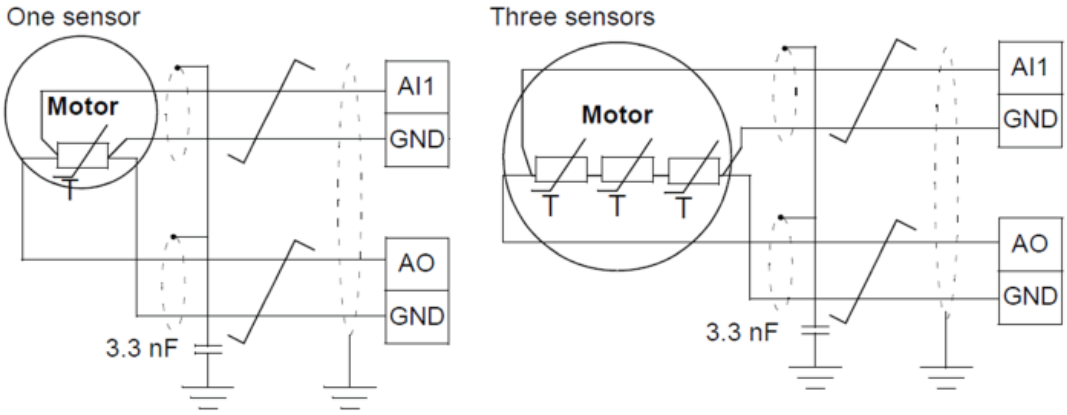
8.31.2 Settings

Parameter	Additional information
9902	PID control activation
4022…4026	Sleep function settings

8.32 Motor temperature measurement through the standard I/O

This section describes the temperature measurement of one motor when the drive I/O terminals are used as the connection interface.

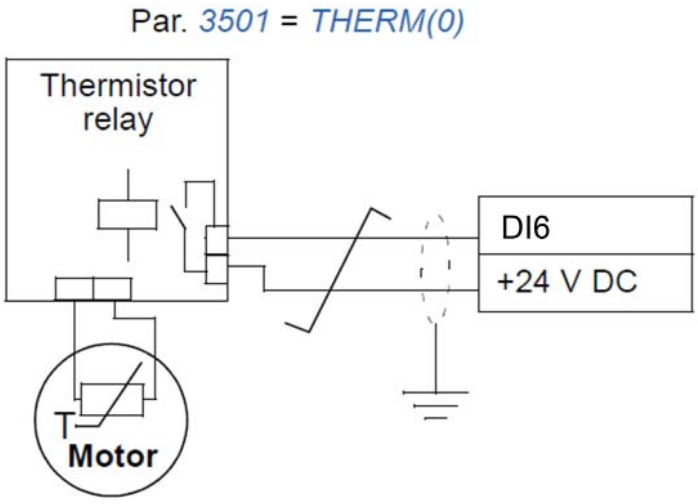
Motor temperature can be measured using Pt100 or PTC sensors connected to analog input and output.



WARNING! According to IEC 664, the connection of the motor temperature sensor requires double or reinforced insulation between motor live parts and the sensor. Reinforced insulation entails a clearance and creepage distance of 8 mm (0.3 in) (400/500 V AC equipment).

If the assembly does not fulfill the requirement, the I/O board terminals must be protected against contact and they may not be connected to other equipment, or the temperature sensor must be isolated from the I/O terminals.

It is also possible to monitor motor temperature by connecting a PTC sensor and a thermistor relay between the +24 V DC voltage supply offered by the drive and a digital input. The figure below displays the connection.



WARNING! According to IEC 664, the connection of the motor thermistor to the digital input requires double or reinforced insulation between motor live parts and the thermistor. Reinforced insulation entails a clearance and creeping distance of 8 mm (0.3 in) (400/500 V AC equipment).

If the thermistor assembly does not fulfill the requirement, the other I/O terminals of the drive must be protected against contact, or a thermistor relay must be used to isolate the thermistor from the digital input.

8.32.1 Settings

Parameter	Additional information
Group 13 ANALOG INPUTS	Analog input settings
Group 15 ANALOG OUTPUTS	Analog output settings
Group 35 MOTOR TEMP MEAS	Motor temperature measurement settings
Other	
At the motor end the cable shield should be grounded through, eg a 3.3 nF capacitor. If this is not possible, the shield is to be left unconnected.	

8.32.2 Diagnostics

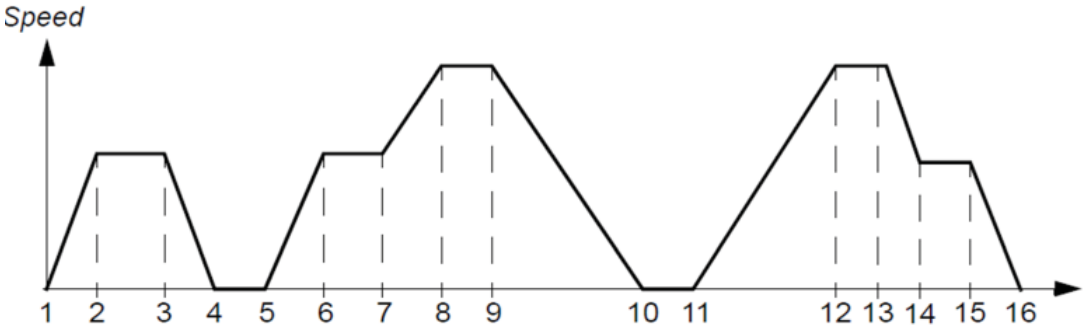
Actual signal	Additional information
0145	Motor temperature
Alarm/Fault	Additional information
MOTOR TEMP/MOT OVERTEMP	Excessive motor temp

8.33 Jogging

The jogging function is typically used to control a cyclical movement of a machine section. One push button controls the drive through the whole cycle: When it is on, the drive starts, accelerates to a preset speed at a preset rate. When it is off, the drive decelerates to zero speed at a preset rate.

The figure and table below describe the operation of the drive. They also represent how the drive shifts to normal operation (= jogging inactive) when the drive start command is switched on. Jog cmd = State of the jogging input, Start cmd = State of the drive start command.

The function operates on a 2 ms time level



Phase	Jog cmd	Start cmd	Description
1-2	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
2-3	1	0	Drive runs at the jogging speed.
3-4	0	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
4-5	0	0	Drive is stopped.
5-6	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
6-7	1	0	Drive runs at the jogging speed.
7-8	x	1	Normal operation overrides the jogging. Drive accelerates to the speed reference along the active acceleration ramp.
8-9	x	1	Normal operation overrides the jogging. Drive follows the speed reference.
9-10	0	0	Drive decelerates to zero speed along the active deceleration ramp.
10-11	0	0	Drive is stopped.
11-12	x	1	Normal operation overrides the jogging. Drive accelerates to the speed reference along the active acceleration ramp.
12-13	x	1	Normal operation overrides the jogging. Drive follows the speed reference.
13-14	1	0	Drive decelerates to the jogging speed along the deceleration ramp of the jogging function.
14-15	1	0	Drive runs at the jogging speed.
15-16	0	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.

x = state can be either 1 or 0

Note: The jogging is not operational when the drive start command is on.

Note: The jogging speed overrides the constant speeds.

Note: The jogging uses ramp stop even if parameter 2102 STOP FUNCTION selection is COAST.

Note: The ramp shape time is set to zero during the jogging (ie linear ramp).

Jogging function uses constant speed 7 as jogging speed and acceleration/deceleration ramp pair 2.

It is also possible to activate jogging function 1 or 2 through fieldbus. Jogging function 1 uses constant speed 7 and jogging function 2 uses constant speed 6. Both functions use acceleration/deceleration ramp pair 2.

8.33.1 Settings

Parameter	Additional information
1004	Jogging activation
1208	Jogging speed
2112	Zero speed delay
2205, 2206	Acceleration and deceleration times
2207	Acceleration and deceleration ramp shape time: Set to zero during the jogging (ie linear ramp).

8.33.2 Diagnostics

Actual signal	Additional information
1401	Jogging function status through RO 1
1402/1406	Jogging function status through RO 2…6

8.34 Brake components

8.34.1 Availability

Braking availability for ACB530 drives, by frame size is:

- R1 and R2 – a built-in brake chopper is standard equipment. Add appropriate resistor, as determined using the following section. Resistors are available from Baldor.
- R3…R6 – does not include an internal brake chopper. Connect a chopper and a resistor, or a brake unit to the DC link terminals on the drive. Contact your Baldor representative for appropriate parts.

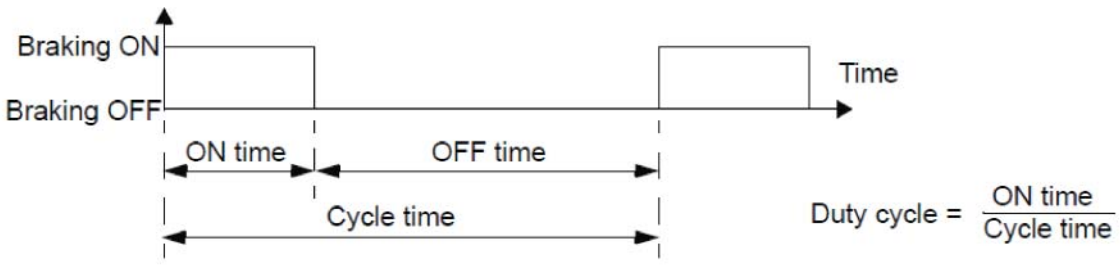
8.34.2 Selecting the braking resistors (frame sizes R1 and R2)

Braking resistor must meet three requirements:

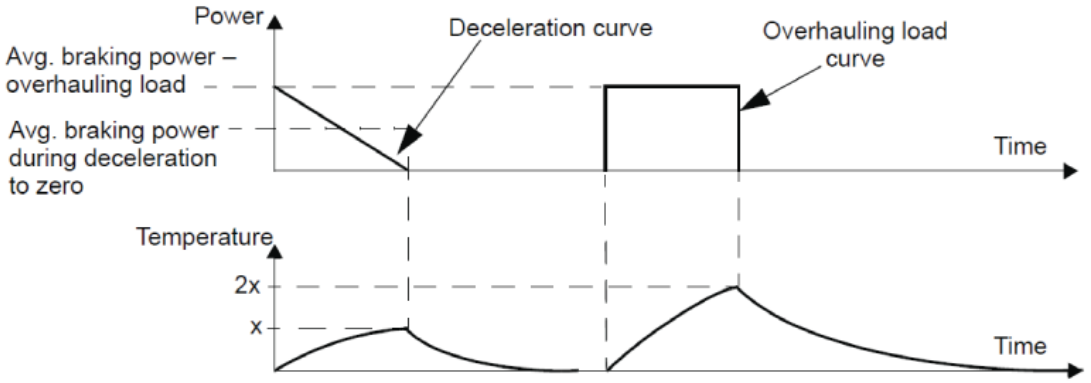
- Resistance must be always higher than the minimum value RMIN defined for the drive type in the following tables. Never use resistance below this value.
- Resistance must be low enough to be able to produce the desired braking torque. To achieve the maximum braking torque (the larger of 150% of heavy duty or 110% of nominal duty), the resistance must not exceed RMAX. If maximum braking torque is not necessary, resistor values can exceed RMAX.
- The resistor power rating must be high enough to dissipate the braking power.

This requirement involves many factors:

  – the maximum continuous power rating for the resistor(s)
  – the rate at which the resistor changes temperature (resistor thermal time constant)
  – maximum braking time ON – If the regeneration (braking) power is larger than the resistor rated power, there is a limit to the ON time, or the resistor overheats before the OFF period begins.
  – minimum braking time OFF – If the regeneration (braking) power is larger than the resistor rated power, the OFF time must be large enough for the resistor to cool between ON periods.
  – the peak braking power requirement
  – type of braking (deceleration to zero vs. overhauling load) – During deceleration to zero, the generated power steadily decreases, averaging half of the peak power. For an overhauling load, the braking is countering an external force (gravity for example) and the braking power is constant. The total heat generated from an overhauling load is double the heat generated
  – from deceleration to zero speed (for the same peak torque and ON time).



  – the peak braking power requirement
  – type of braking (deceleration to zero vs. overhauling load) – During deceleration to zero, the generated power steadily decreases, averaging half of the peak power. For an overhauling load, the braking is countering an external force (gravity for example) and the braking power is constant. The total heat generated from an overhauling load is double the heat generated from deceleration to zero speed (for the same peak torque and ON time).



The many variables in the last requirement above are most easily dealt with using the following tables.

- First, determine your maximum braking time ON (ONMAX), minimum braking time OFF (OFFMIN) and load type (deceleration or overhauling load).
- Calculate duty cycle:

$$\text{Duty Cycle} = \frac{ON_{MAX}}{(ON_{MAX} + OFF_{MIN})} \cdot 100\%$$

- In the appropriate table, find the column that best matches your data:
  - – ONMAX < column specification and
  - – Duty cycle < column specification
- Find the row that matches your drive.
- The minimum power rating for deceleration to zero is the value in the selected row/column.
- For overhauling loads, double the rating in the selected row/column, or use the “Continuous ON” column.

208…240 V drives

Type ACB530-01/U1- see below	Resistance		Resistor[1] minimum continuous power rating				
			Deceleration-to-zero rating				P_{rcont} Continuous ON > 60 s ON > 25% Duty
	R_{MAX}	R_{MIN}	P_{r3} < 3 s ON > 27 s OFF < 10% Duty	P_{r10} < 10 s ON > 50 s OFF < 17% Duty	P_{r30} < 30 s ON > 180 s OFF < 14% Duty	P_{r60} < 60 s ON > 180 s OFF < 25% Duty	
	ohm	ohm	W	W	W	W	W
Three-phase supply voltage, **208…240 V**							
-04A6-2	234	80	45	80	120	200	1100
-06A6-2	160	80	65	120	175	280	1500
-07A5-2	117	44	85	160	235	390	2200
-012A-2	80	44	125	235	345	570	3000
-017A-2	48	44	210	390	575	950	4000
-024A-2	32	30	315	590	860	1425	5500
-031A-2	23	22	430	800	1175	1940	7500

[1] Resistor time constant specification must be > 85 seconds.

380…480 V drives

Type ACB530-01/U1- see below	Resistance		Resistor[1] minimum continuous power rating				
			Deceleration-to-zero rating				P_{rcont} Continuous ON > 60 s ON > 25% Duty
	R_{MAX}	R_{MIN}	P_{r3} < 3 s ON > 27 s OFF < 10% Duty	P_{r10} < 10 s ON > 50 s OFF < 17% Duty	P_{r30} < 30 s ON > 180 s OFF < 14% Duty	P_{r60} < 60 s ON > 180 s OFF < 25% Duty	
	ohm	ohm	W	W	W	W	W
Three-phase supply voltage, **380…480 V**							
-03A3-4	641	120	65	120	175	285	1100
-04A1-4	470	120	90	160	235	390	1500
-05A4-4	320	120	125	235	345	570	2200
-06A9-4	235	80	170	320	470	775	3000
-08A8-4	192	80	210	400	575	950	4000
-012A-4	128	80	315	590	860	1425	5500
-015A-4	94	63	425	800	1175	1950	7500
-023A-4	64	63	625	1175	1725	2850	11000

[1] Resistor time constant specification must be > 85 seconds.

500...600 V drives

Type ACB530-01/U1- see below	Resistance		Resistor[1] minimum continuous power rating				
			Deceleration-to-zero rating				P_{rcont} Continuous ON > 60 s ON > 25% Duty
	R_{MAX}	R_{MIN}	P_{r3} < 3 s ON > 27 s OFF < 10% Duty	P_{r10} < 10 s ON > 50 s OFF < 17% Duty	P_{r30} < 30 s ON > 180 s OFF < 14% Duty	P_{r60} < 60 s ON > 180 s OFF < 25% Duty	
	ohm	ohm	W	W	W	W	W
Three-phase supply voltage, **500...600 V**							
-02A7-6	548	80	93	175	257	425	1462
-03A9-6	373	80	137	257	377	624	2144
-06A1-6	224	80	228	429	629	1040	3573
-09A0-6	149	80	342	643	943	1560	5359
-011A-6	110	60	467	877	1286	2127	7308
-017A-6	75	60	685	1286	1886	3119	10718

[1] Resistor time constant specification must be > 85 seconds.

WARNING! Never use a brake resistor with a resistance below the minimum value specified for the particular drive. The drive and the internal chopper are not able to handle the overcurrent caused by the low resistance.

Symbols

R_{MIN} – Minimum allowed resistance of the braking resistor.

R_{MAX} – Maximum resistance allowed if maximum braking torque is necessary.

P_{rx} – Duty-cycle based resistor power rating in deceleration braking, where "x" is ON_{MAX} time.

8.34.3 Installing and wiring resistors

All resistors must be installed outside the drive module in a place where they can dissipate heat.

WARNING! The surface temperature of the resistor is very high, and air flowing from the resistor is very hot. Materials near the brake resistor must be non-flammable. Provide protection from accidental contact with the resistor.

To ensure that the input fuses protect the resistor cable, use resistor cables with the same rating as used for the power input to the drive.

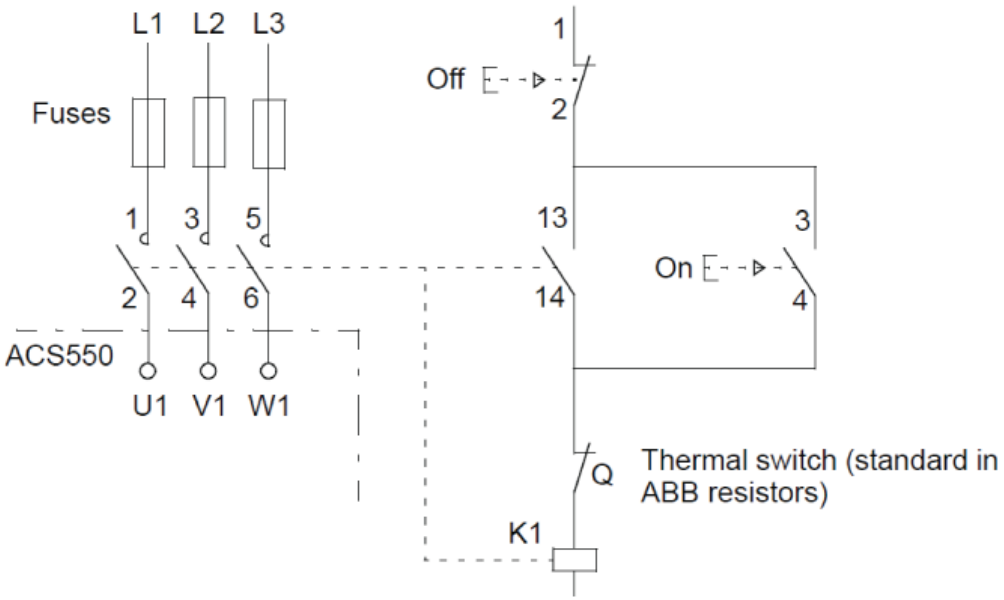
The maximum length of the resistor cable(s) is 10 m (33 ft). See Power connection diagrams for the resistor cable connection points.

8.34.4 Mandatory circuit protection

The following setup is essential for safety – it interrupts the main supply in fault situations involving chopper shorts:

- Equip the drive with a main contactor.
- Wire the contactor so that it opens if the resistor thermal switch opens (an overheated resistor opens the contactor).

Below is a simple wiring diagram example.



8.34.5 Parameter set-up

To enable dynamic braking, switch off the drive's overvoltage control [Set parameter 2005 = 0 (DISABLE)].

Chapter 9
Troubleshooting and Maintenance

9.1 Fault Tracing

9.1.1 In this Chapter

The chapter explains how to reset faults and view the fault history. It also lists all alarm and fault messages including the possible cause and corrective actions.

9.2 Safety

WARNING! Only qualified electricians are allowed to maintain the drive. Read the Safety Notices before you work on the drive.

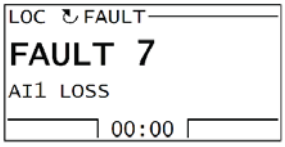
9.3 Diagnostic displays

The drive detects error situations and reports them using:
- the green and red LED on the body of the drive
- the status LED on the control panel (if an Assistant Control Panel is attached to the drive)
- the control panel display (if a control panel is attached to the drive)
- the Fault Word and Alarm Word parameter bits (parameters 0305 to 0309). See Group 03: FB ACTUAL SIGNALS for the bit definitions.

The form of the display depends on the severity of the error. You can specify the severity for many errors by directing the drive to:
- ignore the error situation
- report the situation as an alarm
- report the situation as a fault.

9.3.1 Red – Faults

The drive signals that it has detected a severe error, or fault, by:
- enabling the red LED on the drive (LED is either steady on or blinking)
- showing the steady red status LED on the control panel (if attached to the drive)
- setting an appropriate bit in a Fault Word parameter (0305 to 0307)
- overriding the control panel display with the display of a fault code in the Fault mode (figure on the right)
- stopping the motor (if it was on).

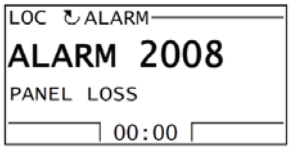


The fault code on the control panel display is temporary. Pressing any of the following keys removes the fault message: MENU, ENTER, UP, or DOWN key.

The message reappears after a few seconds if the control panel is not touched and the fault is still active.

9.3.2 Flashing green – Alarms

For less severe errors, called alarms, the diagnostic display is advisory. For these situations, the drive is simply reporting that it had detected something “unusual.” In these situations, the drive:
- flashes the green LED on the drive (does not apply to alarms that arise from control panel operation errors)
- flashes the green LED on the control panel (if attached to the drive)
- sets an appropriate bit in an Alarm Word parameter (0308 or 0309). See Group 03: FB ACTUAL SIGNALS for the bit definitions
- • overrides the control panel display with the display of an alarm code and/or name in the Fault mode (figures on the right).



Alarm messages disappear from the control panel display after a few seconds. The message returns periodically as long as the alarm condition exists.

9.4 Alarm and Fault Indications

A fault is indicated with a red LED. See section LEDs.

An alarm or fault message on the panel display indicates an abnormal drive status.
Using the information given in this chapter, most alarm and fault causes can be identified and corrected. If not, contact your local Baldor District Office.

To display the alarms on the keypad, set parameter 1610 DISPLAY ALARMS to value 1 (YES).

The four-digit code number in parenthesis after the fault is for the fieldbus communication. See Appendix E for Fieldbus control with embedded fieldbus and Fieldbus control with fieldbus adapter.

9.5 How to Reset

The drive can be reset either by pressing the keypad key RESET (assistant keypad), through digital input or fieldbus, or by turning the supply voltage off for a short time. The source for the fault reset signal is selected by parameter 1604 FAULT RESET SEL. When the fault has been removed, the motor can be restarted.

9.5.1 Fault resetting

The ACB530 can be configured to automatically reset certain faults. Refer to parameter Group 31: AUTOMATIC RESET.

WARNING! If an external source for start command is selected and it is active, the ACB530 may start immediately after fault reset.

9.5.1.1 Flashing red LED

To reset the drive for faults indicated by a flashing red LED:
- Turn the power off for 5 minutes.

9.5.1.2 Red LED

To reset the drive for faults indicated by a red LED (on, not flashing), correct the problem and do one of the following:
- Press RESET from the control panel.
- Turn the power off for 5 minutes.

Depending on the value of 1604 FAULT RESET SEL, the following could also be used toreset the drive:
- digital input
- serial communication.

When the fault has been corrected, the motor can be started.

9.5.1.3 History

For reference, the last three fault codes are stored into parameters 0401, 0412, 0413. For the most recent fault (identified by parameter 0401), the drive stores additional data (in parameters 0402…0411) to aid in troubleshooting a problem. For example, parameter 0404 stores the motor speed at the time of the fault.

The Assistant Control Panel provides additional information about the fault history.
See section Fault Logger mode for more information.

To clear the fault history (all of the Group 04: FAULT HISTORY parameters):

1. Using the control panel in the Parameters mode, select parameter 0401.
2. Press EDIT.
3. Press UP and DOWN at the same time.
4. Press SAVE.

9.5.2 Correcting alarms

The recommended corrective action for alarms is:
- Determine if the alarm requires any corrective action (action is not alwaysrequired).
- Use the table in section Alarm listing following to find and address the root cause of the problem.

Table 9-1 Alarm Listing		
Alarm Code	**Display**	**Description**
2001	OVERCURRENT	Current limiting controller is active. Check for and correct: • Excessive motor load. • Insufficient acceleration time (parameters 2202 ACCELER TIME 1 and 2205 ACCELER TIME 2). • Faulty motor, motor cables or connections.
2002	OVERVOLTAGE	Overvoltage controller is active. Check for and correct: • Static or transient overvoltages in the input power supply. • Insufficient deceleration time (parameters 2203 DECELER TIME 1 and 2206 DECELER TIME 2).
2003	UNDERVOLTAGE	Undervoltage controller is active. Check for and correct: • Undervoltage on mains.
2004	DIR LOCK	The change in direction being attempted is not allowed. Either: • Do not attempt to change the direction of motor rotation, or • Change parameter 1003 DIRECTION to allow direction change (if reverse operation is safe).
2005	IO COMM	Fieldbus communication has timed out. Check for and correct: • Fault setup (3018 COMM FAULT FUNC and 3019 COMM FAULT TIME). • Communication settings (Group 51: EXT COMM MODULE or Group 53: EFB PROTOCOL as appropriate). • Poor connections and/or noise on line.
2006	AI1 LOSS	Analog input 1 is lost, or value is less than the minimum setting. Check: • Input source and connections. • Parameter that sets the minimum (3021). • Parameter that sets the alarm/fault operation (3001),
2007	AI2 LOSS	Analog input 2 is lost, or value is less than the minimum setting. Check: • Input source and connections. • Parameter that sets the minimum (3022). • Parameter that sets the alarm/fault operation (3001).
2008	PANEL LOSS	Panel communication is lost and either: • Drive is in local control mode (the control panel displays LOC), or • Drive is in remote control mode (REM) and is parameterized to accept start/stop, direction or reference from the control panel. To correct check: • Communication lines and connections. • Parameter 3002 PANEL COMM ERR. • Parameters in Group 10: START/STOP/DIR and Group 11: REFERENCE SELECT (if drive operation is REM).
2009	DEVICE OVERTEMP	Drive heatsink is hot. This alarm warns that a DEVICE OVERTEMP fault may be near. R1 through R4: 100 °C (212 °F) R5, R6: 110 °C (230 °F) Check for and correct: • Fan failure. • Obstructions in the air flow. • Dirt or dust coating on the heat sink. • Excessive ambient temperature. • Excessive motor load.
2010	MOTOR TEMP	Motor is hot, based on either the drive's estimate or on temperature feedback. This alarm warns that a MOT OVERTEMP fault trip may be near. Check: • Check for overloaded motor. • Adjust the parameters used for the estimate (3005…3009). • Check the temperature sensors and Group 35: MOTOR TEMPMEAS.
2011	UNDERLOAD	Not used.
2012	MOTOR STALL	Motor is operating in the stall region. This alarm warns that a MOTOR STALL fault trip may be near.

Table 9-1 Alarm Listing		
Alarm Code	**Display**	**Description**
2013 1)	AUTORESET	This alarm warns that the drive is about to perform an automatic fault reset, which may start the motor. • To control automatic reset, use Group 31: AUTOMATIC RESET.
2016/ 2017	RESERVED	Not used.
2018 (Note 1)	PID SLEEP	This alarm warns that the PID sleep function is active, which means that the motor could accelerate when the PID sleep function ends. • To control PID sleep, use parameters 4022…4026 or 4122…4126.
2019	MOTOR MODEL CALC	Performing Motor Model Calc Run.
2020	RESERVED	Not used.
2021	START ENABLE 1 MISSING	This alarm warns that the Start Enable 1 signal is missing. • To control Start Enable 1 function, use parameter 1608. To correct, check: • Digital input configuration. • Communication settings.
2022	START ENABLE 2 MISSING	This alarm warns that the Start Enable 2 signal is missing. • To control Start Enable 2 function, use parameter 1609. To correct, check: • Digital input configuration. • Communication settings.
2023	EMERGENCY STOP	Emergency stop activated.
2025	FIRST START	Signals that a the drive is performing a First Start evaluation of motor characteristics. This is normal the first time the motor is run after motor parameters are entered or changed. See parameter 9910 ID RUN for a description of motor models.
2026	RESERVED	Not used.
2027	USER LOAD CURVE	This alarm warns that the condition defined by parameter 3701 USER LOAD C MODE has been valid longer than half of the time defined by 3703 USER LOAD C TIME.
2028	START DELAY	Shown during the Start delay. See parameter 2113 START DELAY.
1. Even when the relay output is configured to indicate alarm conditions (e.g. parameter1401 RELAY OUTPUT 1 = 5 (ALARM) or 16 (FLT/ALARM)), this alarm is not indicated by a relayoutput.		

9.6 Fault History

When a fault is detected, it is stored in the fault history. The latest faults are stored together with the time stamp.

Parameters 0401 LAST FAULT, 0412 PREVIOUS FAULT 1 and 0413 PREVIOUS FAULT 2 store the most recent faults. Parameters 0404 - 0409 show drive operation data at the time the latest fault occurred. The assistant keypad provides additional information about the fault history. See section Fault logger mode for more information.

9.7 Diagnostics

WARNING! Do not attempt any measurement, parts replacement or other service procedure not described in this manual. Such action will void the warranty, may endanger correct operation and increase downtime and expense.

WARNING! All electrical installation and maintenance work described in this chapter should only be undertaken by qualified service personnel. The safety instructions must be followed.

9.7.3 Correcting faults

The recommended corrective action for faults is:
- Use the table in section Fault listing below to find and address the root cause of the problem.
- Reset the drive. See section Fault resetting.

9.7.3.1 Fault listing

The following table lists the faults by code number and describes each. The fault name is the long form shown in the Fault mode of the Assistant Control Panel when the fault occurs. The fault names shown (for Assistant Control Panel only) in the Fault Logger mode and the fault names for parameter 0401 LAST FAULT may be shorter.

Table 9-1 Fault Listing

Fault code	Fault name in panel	Description and recommended corrective action
1	OVERCURRENT	Output current is excessive. Check for and correct: • Excessive motor load. • Insufficient acceleration time (parameters 2202 ACCELER TIME 1 and 2205 ACCELER TIME 2). • Faulty motor, motor cables or connections.
2	DC OVERVOLT	Intermediate circuit DC voltage is excessive. Check for and correct: • Static or transient overvoltages in the input power supply. • Insufficient deceleration time (parameters 2203 DECELER TIME 1 and 2206 DECELER TIME 2). • Undersized brake chopper (if present). • Verify that overvoltage controller is ON (using parameter 2005).
3	DEV OVERTEMP	Drive heatsink is overheated. Temperature is at or above limit. R1 through R4: 115 °C (239 °F) R5, R6: 125 °C (257 °F) Check for and correct: • Fan failure. • Obstructions in the air flow. • Dirt or dust coating on the heat sink. • Excessive ambient temperature. • Excessive motor load.
4	SHORT CIRC	Fault current. Check for and correct: • A short-circuit in the motor cable(s) or motor. • Supply disturbances.
5	RESERVED	Not used.
6	DC UNDERVOLT	Intermediate circuit DC voltage is not sufficient. Check for and correct: • Missing phase in the input power supply. • Blown fuse. • Undervoltage on mains.
7	AI1 LOSS	Analog input 1 loss. Analog input value is less than AI1 FAULT LIMIT (3021). Check for and correct: • Source and connection for analog input. • Parameter settings for AI1 FAULT LIMIT (3021) and 3001 AI<MIN FUNCTION.
8	AI2 LOSS	Analog input 2 loss. Analog input value is less than AI2 FAULT LIMIT (3022). Check for and correct: • Source and connection for analog input. • Parameter settings for AI2 FAULT LIMIT (3022) and 3001 AI<MIN FUNCTION.
9	MOT OVERTEMP	Motor is too hot, based on either the drive's estimate or on temperature feedback. • Check for overloaded motor. • Adjust the parameters used for the estimate (3005…3009). • Check the temperature sensors and Group 35: MOTOR TEMP MEAS parameters.
10	PANEL LOSS	Panel communication is lost and either: • Drive is in local control mode (the control panel displays LOC), or • Drive is in remote control mode (REM) and is set to accept start/stop, direction or reference from the control panel. To correct check: • Communication lines and connections. • Parameter 3002 PANEL COMM ERR. • Parameters in Group 10: START/STOP/DIR and Group 11: • REFERENCE SELECT (if drive operation is REM).

Fault code	Fault name in panel	Description and recommended corrective action
11	ID RUN FAIL	The Motor ID Run was not completed successfully. Check for and correct: • Motor connections. • Motor parameters 9905…9909.
12	MOTOR STALL	Motor or process stall. Motor is operating in the stall region. Check for and correct: • Excessive load. • Insufficient motor power. • Parameters 3010…3012.
13	RESERVED	Not used.
14	EXT FAULT 1	Digital input defined to report first external fault is active. See parameter 3003 EXTERNAL FAULT 1.
15	EXT FAULT 2	Digital input defined to report second external fault is active. See parameter 3004 EXTERNAL FAULT 2.
16	EARTH FAULT	Possible ground fault detected in the motor or motor cables. The drive monitors for ground faults while the drive is running and while the drive is not running. Detection is more sensitive when the drive is not running and can produce false positives. Possible corrections: • Check for/correct faults in the input wiring. • Verify that motor cable does not exceed maximum specified length. • A delta grounded input power supply and motor cables with highcapacitance may result in erroneous error reports during non-runningtests. To disable response to fault monitoring when the drive is notrunning, use parameter 3023 WIRING FAULT. To disable response to allground fault monitoring, use parameter 3017 EARTH FAULT. **Note:** Disabling earth fault (ground fault) may void the warranty.
17	OBSOLETE	Not used.
18	THERM FAIL	Internal fault. The thermistor measuring the internal temperature of the drive is open or shorted. Contact your local Baldor representative.
19	OPEX LINK	Internal fault. A communication-related problem has been detected on the fiber optic link between the control and OINT boards. Contact your local Baldor representative.
20	OPEX PWR	Internal fault. Exceptionally low voltage detected on the OINT power supply. Contact your local Baldor representative.
21	CURR MEAS	Internal fault. Current measurement is out of range. Contact your local Baldor representative.
22	SUPPLY PHASE	Ripple voltage in the DC link is too high. Check for and correct: • Missing mains phase. • Blown fuse.
24	OVERSPEED	Motor speed is greater than 120% of the larger (in magnitude) of 2001 MINIMUM SPEED or 2002 MAXIMUM SPEED. Check for and correct: • Parameter settings for 2001 and 2002. • Adequacy of motor braking torque. • Applicability of torque control. • Brake chopper and resistor.
25	RESERVED	Not used.
26	DRIVE ID	Internal fault. Configuration Block Drive ID is not valid. Contact your local Baldor representative.
27	CONFIG FILE	Internal configuration file has an error. Contact your local Baldor representative.
28	SERIAL 1 ERR	Fieldbus communication has timed out. Check for and correct: • Fault setup (3018 COMM FAULT FUNC and 3019 COMM FAULT TIME). • Communication settings (Group 51: EXT COMM MODULE or Group 53:EFB PROTOCOL as appropriate). • Poor connections and/or noise on line.
29	EFB CON FILE	Error in reading the configuration file for the embedded fieldbus.
30	FORCE TRIP	Fault trip forced by the fieldbus. See the fieldbus User's Manual.

Fault code	Fault name in panel	Description and recommended corrective action
31	EFB 1	Fault code reserved for the embedded fieldbus (EFB) protocol application. The meaning is protocol dependent
32	EFB 2	
33	EFB 3	
34	MOTOR PHASE	Fault in the motor circuit. One of the motor phases is lost. Check for and correct: • Motor fault. • Motor cable fault. • Thermal relay fault (if used). • Internal fault.
35	OUTP WIRING	Possible power wiring error detected. When the drive is not running it monitors for an improper connection between the drive input power and the drive output. Check for and correct: • Proper input wiring – line voltage is NOT connected to drive output. • The fault can be erroneously declared if the input power is a deltaground ed system and motor cable capacitance is large. This fault can be disabled using parameter 3023 WIRING FAULT.
36	INCOMPATIBLE SW	The drive cannot use the software. • Internal fault. • The loaded software is not compatible with the drive. • Call support representative.
37	CB OVERTEMP	Drive control board is overheated. The fault trip limit is 88 °C. Check for and correct: • Excessive ambient temperature. • Fan failure. • Obstructions in the air flow.
38	USER LOAD CURVE	Condition defined by parameter 3701 USER LOAD C MODE has been valid longer than the time defined by 3703 USER LOAD C TIME.
101… 199	SYSTEM ERROR	Error internal to the drive. Contact your local Baldor representative and report the error number.
201… 299	SYSTEM ERROR	Error in the system. Contact your local Baldor representative and report the error number.
–	UNKNOWN DRIVE TYPE: ACB530 SUPPORTED DRIVES: X	Wrong type of panel, i.e. panel that supports drive X but not the ACB530, has been connected to the ACB530.

Faults that indicate conflicts in the parameter settings are listed below.

Fault code	Fault name in panel	Description and recommended corrective action
1000	PAR HZRPM	Parameter values are inconsistent. Check for any of the following: • 2001 MINIMUM SPEED > 2002 MAXIMUM SPEED. • 2007 MINIMUM FREQ > 2008 MAXIMUM FREQ. • 2001 MINIMUM SPEED / 9908 MOTOR NOM SPEED is outside proper range (> 50). • 2002 MAXIMUM SPEED / 9908 MOTOR NOM SPEED is outside proper range (> 50). • 2007 MINIMUM FREQ / 9907 MOTOR NOM FREQ is outside proper range (> 50). • 2008 MAXIMUM FREQ / 9907 MOTOR NOM FREQ is outside proper range (> 50).
1002	RESERVED	Not used.
1003	PAR AI SCALE	Parameter values are inconsistent. Check for any of the following: • 1301 MINIMUM AI1 > 1302 MAXIMUM AI1. • 1304 MINIMUM AI2 > 1305 MAXIMUM AI2.
1004	PAR AO SCALE	Parameter values are inconsistent. Check for any of the following: • 1504 MINIMUM AO1 > 1505 MAXIMUM AO1. • 1510 MINIMUM AO2 > 1511 MAXIMUM AO2.

Fault code	Fault name in panel	Description and recommended corrective action
1005	PAR PCU 2	Parameter values for power control are inconsistent: Improper motor nominal kVA or motor nominal power. Check for the following: • 1.1 < (9906 MOTOR NOM CURR · 9905 MOTOR NOM VOLT · 1.73 / PN) < 3.0 where: PN = 1000 · 9909 MOTOR NOM POWER (if units are kW) or PN = 746 · 9909 MOTOR NOM POWER (if units are hp, e.g. in US)
1007	PAR FIELDBUS MISSING	Parameter values are inconsistent. Check for and correct: • A parameter is set for fieldbus control (e.g. 1001 EXT1 COMMANDS = 10 (COMM)), but 9802 COMM PROT SEL = 0.
1009	PAR PCU 1	Parameter values for power control are inconsistent: Improper motor nominal frequency or speed. Check for both of the following: • 1 < (60 · 9907 MOTOR NOM FREQ / 9908 MOTOR NOM SPEED < 16 • 0.8 < 9908 MOTOR NOM SPEED / (120 · 9907 MOTOR NOM FREQ / Motor Poles) < 0.992
1010/ 1011	RESERVED	Not used.
1015	RESERVED	Not used.
1016	PAR USER LOAD C	Parameter values for the user load curve are inconsistent. Check that the following conditions are met: • 3704 LOAD FREQ 1 < 3707 LOAD FREQ 2 < 3710 LOAD FREQ 3 < 3713 LOAD FREQ 4 < 3716 LOAD FREQ 5. • 3705 LOAD TORQ LOW 1 < 3706 LOAD TORQ HIGH 1. • 3708 LOAD TORQ LOW 2 < 3709 LOAD TORQ HIGH 2. • 3711 LOAD TORQ LOW 3 < 3712 LOAD TORQ HIGH 3. • 3714 LOAD TORQ LOW 4 < 3715 LOAD TORQ HIGH 4. • 3717 LOAD TORQ LOW 5 < 3718 LOAD TORQ HIGH 5.

9.8 Embedded Fieldbus Faults

Embedded fieldbus faults can be traced by monitoring group EFB PROTOCOL parameters. See also fault/alarm SERIAL 1 ERR (0028).

9.8.1 No Master Device

If there is no master device on line, parameter 5306 EFB OK MESSAGES and 5307 EFB CRC ERRORS values remain unchanged.
What to do:
- Check that the network master is connected and properly configured.
- Check the cable connection.

9.8.2 Same Device Address

If two or more devices have the same address, parameter 5307 EFB CRC ERRORS value increases with every read/write command.
What to do:
- Check the device addresses. No two devices on line may have the same address.

9.8.3 Incorrect Wiring

If the communication wires are swapped (terminal A on one device is connected to terminal B on another device), parameter 5306 EFB OK MESSAGESS value remains unchanged and parameter 5307 EFB CRC ERRORS increases.
What to do:
- Check the RS-232/EIA-485 interface connection.

9.9 Maintenance

9.9.1 Maintenance Intervals

If installed in an appropriate environment, the drive requires very little maintenance. The table lists the routine maintenance intervals recommended by Baldor.

Table 9-2 Maintenance Interval Instruction

Maintenance	Interval	Instruction
Heatsink temperature check and cleaning	Depends on the dustiness of the environment (every 6…12 months)	See Heatsink
Main cooling fan replacement	Every six years	See Main fan replacement on
Internal enclosure cooling fan replacement (IP54 / UL type 12 drives)	Every three years.	See Internal enclosure fan replacement
Capacitor reforming	Every year when stored	See Reforming
Capacitor replacement (frame sizes R5 and R6)	Every nine years	See Replacement
Replace battery in the Assistant Control Panel	Every ten years	See Battery

Consult your local Baldor District Office for more details on the maintenance. On the Internet, go to http://www.baldor.com.

9.9.2 Heatsink

The heatsink fins accumulate dust from the cooling air. Since a dusty heatsink is less efficient at cooling the drive, overtemperature faults become more likely. In a “normal” environment (not dusty, not clean) check the heatsink annually, in a dusty environment check more often.

Clean the heatsink as follows (when necessary):
1. Remove power from the drive.
2. Remove the cooling fan (see section Main fan replacement).
3. Blow clean compressed air (not humid) from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust.

Note: If there is a risk of the dust entering adjoining equipment, perform the cleaning in another room.

4. Reinstall the cooling fan.
5. Restore power.

9.9.3 Main fan replacement

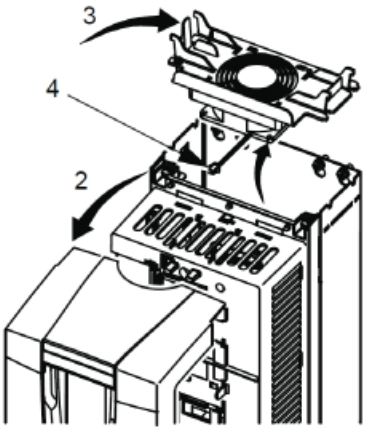
The drive’s main cooling fan has a life span of about 60 000 operating hours at maximum rated operating temperature and drive load. The expected life span doubles for each 10 °C (18 °F) drop in the fan temperature (fan temperature is a function of ambient temperatures and drive loads).

Fan failure can be predicted by the increasing noise from fan bearings and the gradual rise in the heatsink temperature in spite of heatsink cleaning. If the drive is operated in a critical part of a process, fan replacement is recommended once these symptoms start appearing. Replacement fans are available from Baldor. Do not use other than Baldor specified spare parts.

9.9.3.1 Frame sizes R1 through R4

Frame sizes R1 through R4
To replace the fan:

1. Remove power from the drive.
2. Remove drive cover.
3. For frame size:
   - R1, R2: Press together the retaining clips on the fan cover sides, and lift.
   - R3, R4: Press in on the lever located on the left side of the fan mount, and rotate the fan up and out.
4. Disconnect the fan cable.
5. Reinstall the fan in reverse order.
6. Restore power.

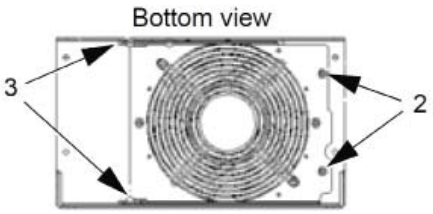


9.9.3.2 Frame size R5

To replace the fan:

1. Remove power from drive.
2. Remove the screws attaching the fan.
3. Remove the fan: Swing the fan out on its hinges.
4. Disconnect the fan cable.
5. Reinstall the fan in reverse order.
6. Restore power.

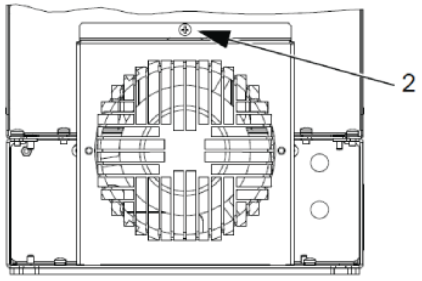
Arrows in the fan show the directions of the rotation and air flow.

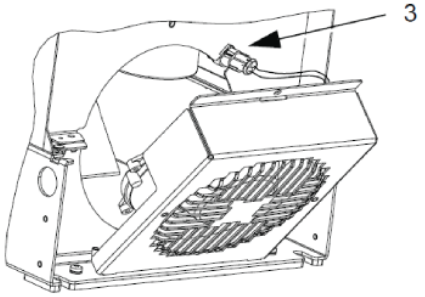


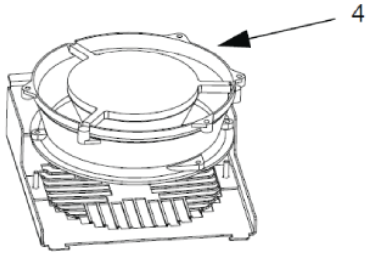
9.9.3.3 Frame size R6

To replace the fan:

1. Remove power from the drive.
2. Remove the screw attaching the fan casing and let the casing lean down against the limiters.
3. Slide out the cable connector and disconnect it.
4. Take off the casing and replace the fan onto the casing's pins.
5. Reinstall the casing in reverse order.
6. Restore power.







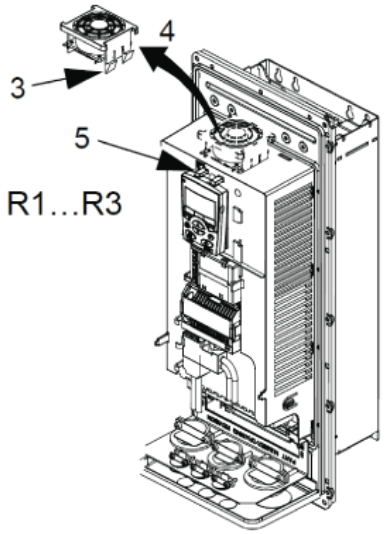
9.9.4 Internal Enclosure Cooling Fan

IP54 / UL type 12 enclosures have an additional internal fan to circulate air inside the enclosure.

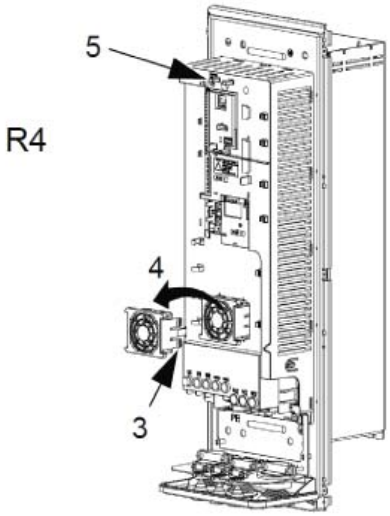
9.9.4.1 Frame sizes R1 - R4

To replace the internal enclosure fan in frame sizes R1 to R3 (located at the top of the drive) and R4 (located in front of the drive):

1. Remove power from the drive.
2. Remove the front cover.
3. The housing that holds the fan in place has barbed retaining clips at each corner. Press all four clips toward the center to release the barbs.



4. When the clips/barbs are free, pull the housing up to remove from the drive.
5. Disconnect the fan cable.
6. Install the fan in reverse order, noting that:
   - The fan air flow is up (refer to the arrow on fan).
   - The fan wire harness is toward the front.
   - The notched housing barb is located in the right-rear corner.
   - The fan cable connects just forward of the fan at the top of the drive.



9.9.4.2 Frame sizes R5 and R6

To replace the internal enclosure fan in frame sizes R5 or R6:

1. Remove power from the drive.
2. Remove the front cover.
3. Lift the fan out and disconnect the cable.
4. Install the fan in reverse order.
5. Restore power.

9.9.5 Capacitors

9.9.5.1 Reforming the Capacitors

The capacitors must be reformed if the drive has been stored for a year. See section Type designation label to find the manufacturing date from the serial number. For information on reforming the capacitors, refer to Guide for capacitor reforming in ACB530 available on the Internet (go to http://www.baldor.com).

9.9.6 Power Connections

WARNING! Read and follow all Safety Notices. Ignoring the Safety Notices can cause physical injury or death, or damage to the equipment.

1. Stop the drive and disconnect it from the power line. Wait for five minutes to let the drive DC capacitors discharge. Ensure by measuring with a multimeter (impedance at least 1 Mohm) that there is no voltage present.
2. Check the tightness of the power cable connections. Use the tightening torques given. Terminal and lead-through data for the power cables.
3. Restore power.

9.9.7 Keypad

9.9.7.1 Cleaning the Keypad

Use a soft damp cloth to clean the keypad. Avoid harsh cleaners which could scratch the display window.

9.9.7.2 Changing the Battery in the Assistant Keypad

A battery is only used in assistant keypads that have the clock function available and enabled. The battery keeps the clock operating in memory during power interruptions.

The expected life for the battery is greater than ten years. To remove the battery, use a coin to rotate the battery holder on the back of the keypad. Replace the battery with type CR2032.

Note: The battery is NOT required for any keypad or drive functions, except the clock.

Chapter A
Technical Specifications

A.1 Standards

Drive compliance with the following standards is identified by the standard “marks” on the type designation label.

A.1.1 Design and Test Standards

- EN 50178: Electronic equipment for use in power installations.
- IEC/EN 60204-1: Safety of machinery. Electrical equipment of machines.
  Part 1: General requirements. Provisions for compliance: The final assembler of the machine is responsible for installing: - an emergency-stop device
  - a supply disconnecting device.
- IEC/EN 60529: Degrees of protection provided by enclosures (IP code).
- IEC 60664-1: Insulation coordination for equipment within low-voltage systems.
  Part 1: Principles, requirements and tests
- IEC/EN 61800-5-1: Adjustable speed electrical power drive systems.
  Part 5-1: Safety requirements. Electrical, thermal and energy.
- IEC/EN 61800-3: Adjustable speed electrical power drive systems.
  Part 3: EMC requirements and specific test methods.
- IEC/EN 61000-3-12: Electromagnetic compatibility (EMC).
  Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and = 75 A per phase

UL508C: Standard for Safety, Power Conversion Equipment.

- CSA C22.2 No. 14: Standard for Industrial Control Equipment.

A.1.2 Environmental Test Standards

A.1.3 Marks

CE

See also Appendix C for general recommendations for CE compliance.

A CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage and EMC Directives.

Note: The 600V ACB530-U1 drives are not CE approved.

A.2 Applicable standards

Drive compliance with the following standards is identified by the standard “marks” on the type designation label.

Table A-1 Marks

Mark	Applicable standards	
CE	EN 50178 (1997)	Electronic equipment for use in power installations
	IEC/EN 60204-1 (2005)	Safety of machinery. Electrical equipment of machines. Part 1: General requirements. Provisions for compliance: The final assembler of the machine is responsible for installing: • an emergency-stop device • a supply disconnecting device.
	IEC/EN 60529 (2004)	Degrees of protection provided by enclosures (IP code)
	IEC 60664-1 (2002)	Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests
	IEC/EN 61800-5-1 (2003)	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements. Electrical, thermal and energy
	IEC/EN 61800-3 (2004)	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods

Table A-1 Marks		
Mark	**Applicable standards**	
	IEC/EN 61000-3-12	Electromagnetic compatibility (EMC). Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and = 75 A per phase
	IEC/EN 61800-3 (2004)	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods
c UL us LISTED	UL 508C	UL Standard for Safety, Power Conversion Equipment, third edition
	C22.2 No. 14	CSA Standard for Industrial Control Equipment (for ACB530-U1 drives only)

A.2.1 CE Marking

CE

A CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage and EMC Directives.

Note: The 600 V ACB530-U1 drives are not CE approved.

A.2.1.1 Compliance with the EMC Directive

The Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (IEC/EN 61800-3 [2004]) covers requirements stated for drives.

A.2.1.1 Compliance with IEC/EN 61800-3 (2004)

Refer to Appendix C for information.

A.2.2 C-Tick Marking

The drive carries C-Tick marking.

C-Tick marking is required in Australia and New Zealand. A C-Tick mark is attached to the drive to verify compliance with the relevant standard (IEC 61800-3 (2004) – Adjustable speed electrical power drive systems – Part 3: EMC product standard including specific test methods), mandated by the Trans-Tasman Electromagnetic Compatibility Scheme.

The Trans-Tasman Electromagnetic Compatibility Scheme (EMCS) was introduced by the Australian Communication Authority (ACA) and the Radio Spectrum Management Group (RSM) of the New Zealand Ministry of Economic Development (NZMED) in November 2001. The aim of the scheme is to protect the radio frequency spectrum by introducing technical limits for emission from electrical/ electronic products.

A.2.2.1 Compliance with IEC/EN 61800-3 (2004)

Refer to Appendix C for information.

A.2.3 UL/CSA markings

An UL mark is attached to ACB530 drives to verify that the drive follows the provisions of UL 508C.

A CSA mark is attached to ACB530-U1 type drives to verify that the drive follows the provisions of C22.2 NO. 14.

The ACB530 is suitable for use in a circuit capable of delivering not more than 100 kA RMS symmetrical amperes, 600 V maximum. The ampere rating is based on tests done according to UL 508.

Branch circuit protection must be provided in accordance with local codes.

The ACB530 has an electronic motor protection feature that complies with the requirements of UL 508C and, for ACB530-U1, C22.2 No. 14. When this feature is selected and properly adjusted, additional overload protection is not required unless more than one motor is connected to the drive or unless additional protection is required by applicable safety regulations. See parameters 3005 (MOT THERM PROT) and 3006 (MOT THERM RATE).

The drives are to be used in a controlled environment. See section Ambient conditions on page 300 for specific limits.

Note: For open type enclosures, i.e. drives without the conduit box and/or cover for IP21 / UL type 1 drives, or without the conduit plate and/or hood for IP54 / UL type 12 drives, the drive must be mounted inside an enclosure in accordance with National Electric Code and local electrical codes.

Brake choppers, when applied with appropriately sized brake resistors, will allow the drive to dissipate regenerative energy (normally associated with quickly decelerating a motor). Frame sizes R1 and R2 have a built-in brake chopper as standard equipment. For frame sizes R3…R6, contact your Baldor representative for appropriate parts. See section Brake components.

A.3 Ambient Conditions

The following table lists the ACB530 environmental requirements.

Table A-1 Ambient Environmental Requirements

	Installation site	Storage and transportation in the protective package
Altitude	• 0…1000 m (0…3 300 ft) • 1000…2000 m (3 300…6 600 ft) if PN and I2N derated 1% every 100 m above 1000 m (300 ft above 3 300 ft)	
Ambient temperature	• Min. -15 °C (5 °F) – no frost allowed • Max. (fsw = 1 or 4) 40 °C (104 °F); 50 °C (122 °F) if PN and I2N derated to 90% • Max. (fsw = 8) 40 °C (104 °F) if PN and I2N derated to 80% • Max. (fsw = 12) 30 °C (86 °F) if PN and I2N derated to 65% (to 50% for 600 V, R4 frame sizes, that is for ACB530-U1-032A-6 … ACB530-U1- 062A-6)	-40…70 °C (-40…158 °F)
Relative humidity	5…95%, no condensation allowed	

Table A-1 Ambient Environmental Requirements		
	Installation site	**Storage and transportation in the protective package**
Contamination levels (IEC 721-3-3)	• No conductive dust allowed. • The ACS550 should be installed in clean air according to enclosure classification. • Cooling air must be clean, free from corrosive materials and free from electrically conductive dust. • Chemical gases: Class 3C2 • Solid particles: Class 3S2	Storage • No conductive dust allowed. • Chemical gases: Class 1C2 • Solid particles: Class 1S2 Transportation • No conductive dust allowed. • Chemical gases: Class 2C2 • Solid particles: Class 2S2

The following table lists the standard stress testing that the ACS550 passes.

Stress tests		
	Without shipping package	**Inside shipping package**
Sinusoidal vibration	Mechanical conditions: In accordance with IEC 60721-3-3, Class 3M4 • 2…9 Hz 3.0 mm (0.12 in) • 9…200 Hz 10 m/s2 (33 ft/s2)	In accordance with ISTA 1A and 1B specifications.
Shock	Not allowed	In accordance with IEC 68-2-29: max. 100 m/s2 (330 ft/s2), 11ms
Free fall	Not allowed	• 76 cm (30 in), frame size R1 • 61 cm (24 in), frame size R2 • 46 cm (18 in), frame size R3 • 31 cm (12 in), frame size R4 • 25 cm (10 in), frame size R5 • 15 cm (6 in), frame size R6

A.4 Materials

Table A-1 Material Specifications	
Drive enclosure	• PC/ABS 2.5 mm, color NCS 1502-Y or NCS 7000-N • Hot-dip zinc coated steel sheet 1.5…2 mm, thickness of coating 20 micrometers. If the surface is painted, the total thickness of the coating (zinc and paint) is 80…100 micrometers. • Cast aluminium AlSi • Extruded aluminium AlSi
Package	Corrugated board, expanded polystyrene, plywood, raw wood (heat dried). Package wrap consists of one or more of the following: PE-LD plastic wrap, PP or steel bands.
Disposal	The drive contains raw materials that should be recycled to preserve energy and natural resources. The package materials are environmentally compatible and recyclable. All metal parts can be recycled. The plastic parts can either be recycled or burned under controlled circumstances, according to local regulations. Most recyclable parts are marked with recycling marks. If recycling is not feasible, all parts excluding electrolytic capacitors and printed circuit boards can be landfilled. The DC capacitors contain electrolyte and, if the drive is not provided with the RoHS marking, the printed circuit boards contain lead, both of which are classified as hazardous waste within the EU. They must be removed and handled according to local regulations. For further information on environmental aspects and more detailed recycling instructions, please contact your local Baldor distributor.

A.5 Efficiency

Approximately 98% at nominal power level.

Chapter B
Parameter Tables

B.1 Parameter Settings by Group

Table B-1 Parameter Settings by Group

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
START-UP DATA	**LANGUAGE** (9901)	Default: 0 (English) Range: 0 - 2	
	OPERATING MODE (9902)	Default: 1 Range: 1 - 6	
	CONTROL TYPE (9904)	Default: 2 Range: 1 - 2	
	MOTOR RATED VOLTS (9905)	Default: -U1-yyyy-2:230V -U1-yyyy-4: 460 V -U1-yyyy-6: 575 V Range: -U1-yyyy-2: 115…345 V -U1-yyyy-4: 230…690 V -U1-yyyy-6: 288…862 V	
	MOTOR RATED AMPS (9906)	Default: $1.0 \cdot /_{2hd}$ Range: $0.2 \cdot /_{2hd}$ - $2.0 \cdot /_{2hd}$ (where $/_{2hd}$ is drive current)	
	MOTOR RATED FREQ (9907)	Default: -U1: 60.0 Hz Range: 10.0 - 500.0 Hz (typically 50 or 60 Hz)	
	MOTOR RATED SPEED (9908)	Default: Dependent Upon Size Range: 50 - 30,000 RPM	
	MOTOR RATED HP (9909)	Default: $1.0 \cdot P_{hd}$ Range: $0.2 \cdot P_{hd}$ - $3.0 \cdot P_{hd}$	
	CALC MOTOR MODEL (9910)	Default: 0 Range: 0 - 1	
	MOTOR COSPHI (9915)	Default: 0 Range: 0 - 0.97	
	SPEED & DIR (0101)	**Read Only** Range: -30000 to 30000 RPM	
	SPEED (0102)	**Read Only** Range: 0 to 30000 RPM	
	OUTPUT FREQ (0103)	**Read Only** Range: 0.0 - 500.0 Hz	
	CURRENT (0104)	**Read Only** Range: $0.0 - 2.0 \cdot /_{2hd}$	
	TORQUE (0105)	**Read Only** Range: -200.0 to 200.0%	
	POWER (0106)	**Read Only** Range: $-2.0 \cdot P_{hd}$ to $2.0 \cdot P_{hd}$	
	DC BUS VOLTAGE (0107)	**Read Only** Range: $0 \cdot V_{dN}$ to $2.5 \cdot V_{dN}$	
	OUTPUT VOLTAGE (0109)	Default: Range: $0 \cdot V_{dN}$ to $2.0 \cdot V_{dN}$	
	DRIVE TEMP (0110)	**Read Only** Range: 0.0 - 150.0°C	
	EXTERNAL REF 1 (0111)	**Read Only** Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
START-UP DATA (Continued)	**EXTERNAL REF 2** (0112)	**Read Only** Range: 0.0 - 100.0% (0.0 - 600.0% for torque)	
	CTRL LOCATION (0113)	**Read Only** Range: 0 - 2	
	RUN TIME (R) (0114)	**Read Only** Range: 0 - 9999 h	
	KWH COUNTER (0115)	**Read Only** Range: 0 - 65535 kWh	
	APPL BLK OUTPUT (0116)	**Read Only** Range: 0.0 - 100.0% (0.0 - 600.0% for torque)	
	DI 1-3 STATUS (0118)	**Read Only** Range: 000 - 111 (0 - 7 decimal)	
	DI 4-6 STATUS (0119)	**Read Only** Range: 000 - 111 (0 - 7 decimal)	
	AI 1 (0120)	**Read Only** Range: 0.0 - 100.0%	
	AI 2 (0121)	**Read Only** Range: 0.0 - 100.0%	
	RO 1-3 STATUS (0122)	**Read Only** Range: 000 - 111 (0 - 7 decimal)	
	AO 1 (0124)	**Read Only** Range: 0.0 - 20.0mA	
	AO 2 (0125)	**Read Only** Range: 0.0 - 20.0mA	
	PID 1 OUTPUT (0126)	**Read Only** Range: -1000.0 to 1000.0%	
	PID 1 SETPNT (0128)	**Read Only** Range: Unit and scale defined by par. 4006/4106 and 4007/4107	
	PID 1 FBK (0130)	**Read Only** Range: Unit and scale defined by par. 4006/4106 and 4007/4107	
	PID 1 DEVIATION (0132)	**Read Only** Range: Unit and scale defined by par. 4006/4106 and 4007/4107	
	COMM RO WORD (0134)	**Read Only** Range: 0 - 65535	
	COMM VALUE 1 (0135)	**Read Only** Range: -32768 to +32767	
	COMM VAULE 2 (0136)	**Read Only** Range: -32768 to +32767	
	PROCESS VAR 1 (0137)	**Read Only** Range:	
	PROCESS VAR 2 (0138)	**Read Only** Range:	
	PROCESS VAR 3 (0139)	**Read Only** Range:	
	RUN TIME (0140)	**Read Only** Range: 0.00 - 499.99 kh	
	MWH COUNTER (0141)	**Read Only** Range: 0 - 65535 MWh	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
START-UP DATA (Continued)	**REVOLUTION CNTR** (0142)	**Read Only** Range: 0 - 65535 Mrev	
	DRIVE ON TIME HI (0143)	**Read Only** Range: 0 - 65535 days	
	DRIVE ON TIME LO (0144)	**Read Only** Range: 00:00:00 - 23:59:58	
	MOTOR TEMP (0145)	**Read Only** Range: Par. 3501 = 1 to 3: -10 to 200°C Par. 3501 = 4: 0 to 5000 ohm Par. 3501 = 5 to 6: 0 to 1	
	CB TEMP (0150)	**Read Only** Range: -20.0 to 150.0°C	
	MOT THERM STRESS (0153)	**Read Only** Range: 0.0 - 100.0%	
	PID COMM VALUE 1 (0158)	**Read Only** Range: -32768 to +32767	
	PID COMM VALUE 2 (0159)	**Read Only** Range: -32768 to +32767	
	SAVED KWH (0174)	**Read Only** Range: 0.0 - 999.9 kWh	
	SAVED MWH (0175)	**Read Only** Range: 0 - 65535 MWh	
	SAVED AMOUNT 1 (0176)	**Read Only** Range: 0.0 - 999.9	
	SAVED AMOUNT 2 (0177)	**Read Only** Range: 0 - 65535	
	SAVED CO2 (0178)	**Read Only** Range: 0.0 - 6553.5 tn	
FB ACTUAL SIGNALS	**FB CMD WORD 1** (0301)	**Read Only** Range:	
	FB CMD WORD 2 (0302)	**Read Only** Range:	
	FB STS WORD 1 (0303)	**Read Only** Range:	
	FB STS WORD 2 (0304)	**Read Only** Range:	
	FAULT WORD 1 (0305)	**Read Only** Range:	
	FAULT WORD 2 (0306)	**Read Only** Range:	
	FAULT WORD 3 (0307)	**Read Only** Range:	
	ALARM WORD 1 (0308)	**Read Only** Range:	
	ALARM WORD 2 (0309)	**Read Only** Range:	
FAULT HISTORY	**LAST FAULT** (0401)	**Read Only** Range: Fault codes (panel displays as text)	
	FAULT TIME 1 (0402)	**Read Only** Range: Date dd.mm.yy / power-on time in days	
	FAULT TIME 2 (0403)	**Read Only** Range: Time hh.mm.ss	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
FAULT HISTORY (Continued)	**SPEED AT FLT** (0404)	**Read Only** Range: -32768 to +32767	
	FREQ AT FLT (0405)	**Read Only** Range: -3276.8 to +3276.7	
	VOLTAGE AT FLT (0406)	**Read Only** Range: 0.0 - 6553.5	
	CURRENT AT FLT (0407)	**Read Only** Range: 0.0 - 6553.5	
	TORQUE AT FLT (0408)	**Read Only** Range: -3276.8 to +3276.7	
	STATUS AT FLT (0409)	**Read Only** Range: 0000 - FFFF hex	
	DI 1-3 AT FLT (0410)	**Read Only** Range: 000 - 111 (0 - 7 decimal)	
	DI 4-6 AT FLT (0411)	**Read Only** Range: 000 - 111 (0 - 7 decimal)	
	PREVIOUS FAULT 1 (0412)	**Read Only** Range: As par. 0401	
	PREVIOUS FAULT 2 (0413)	**Read Only** Range: As par. 0401	
START/STOP/ DIR	**EXT1 COMMANDS** (1001)	Default: 2 (DI1, 2) Range: 0 - 10	
	EXT2 COMMANDS (1002)	Default: 0 (NOT SEL) Range: 0 - 14	
	DIRECTION (1003)	Default: 3 Range: 1 - 3	
	JOGGING SEL (1004)	Default: 0 (NOT SEL) Range: -6 to 6	
REFERENCE SELECT	**KEYPAD REF SEL** (1101)	Default: 1 Range: 1 - 2	
	EXT1/EXT2 SEL (1102)	Default: 0 Range: -6 to 8,	
	REF1 SELECT (1103)	Default: 1 Range: 0 - 17, 20 - 21	
	REF1 MIN (1104)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	REF1 MAX (1105)	Default: 60.0 (62.0) Hz / 1800 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	REF2 SELECT (1106)	Default: 2 Range: 0 - 17, 19 - 21	
	REF2 MIN (1107)	Default: 0.0% Range: 0.0 - 100.0% (0.0 - 600.0% for torque)	
	REF2 MAX (1108)	Default: 100.0% Range: 0.0 - 100.0% (0.0 - 600.0% for torque)	
CONSTANT SPEEDS	**CONST SPEED SEL** (1201)	Default: 9 Range -14 to 19	
	CONST SPEED 1 (1202)	Default: 6.0 Hz / 360 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	CONST SPEED 2 (1203)	Default: 12.0 Hz / 720 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
CONSTANT SPEEDS (Continued)	**CONST SPEED 3** (1204)	Default: 18.0 Hz / 1080 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	CONST SPEED 4 (1205)	Default: 24.0 Hz / 1440 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	CONST SPEED 5 (1206)	Default: 30.0 Hz / 1800 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	CONST SPEED 6 (1207)	Default: 48.0 Hz / 2880 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	CONST SPEED 7 (1208)	Default: 60.0 Hz / 3600 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
ANALOG INPUTS	**MINIMUM AI1** (1301)	Default: 0.0% Range: 0.0 - 100.0%	
	MAXIMUM AI1 (1302)	Default: 100.0% Range: 0.0 - 100.0%	
	FILTER AI1 (1303)	Default: 0.1 s Range: 0.0 - 10.0 s	
	MINIMUM AI2 (1304)	Default: 0.0% Range: 0.0 - 100.0%	
	MAXIMUM AI2 (1305)	Default: 100.0% Range: 0.0 - 100.0%	
	FILTER AI2 (1306)	Default: 0.1 s Range: 0.0 - 10.0 s	
RELAY OUTPUTS	**RELAY OUTPUT 1** (1401)	Default: 1 Range: 0 - 36, 46, 47, 52	
	RELAY OUTPUT 2 (1402)	Default: 2 Range: 0 - 36, 46, 47, 52	
	RELAY OUTPUT 3 (1403)	Default: 3 Range: 0 - 36, 46, 47, 52	
	RO 1 ON DELAY (1404)	Default: 0.0 s Range: 0.0 - 3600.0 s	
	RO 1 OFF DELAY (1405)	Default: 0.0 s Range: 0.0 - 3600.0 s	
	RO 2 ON DELAY (1406)	Default: 0.0 s Range: 0.0 - 3600.0 s	
	RO 2 OFF DELAY (1407)	Default: 0.0 s Range: 0.0 - 3600.0 s	
	RO 3 ON DELAY (1408)	Default: 0.0 s Range: 0.0 - 3600.0 s	
	RO 3 OFF DELAY (1409)	Default: 0.0 s Range: 0.0 - 3600.0 s	
ANALOG OUTPUTS	**AO1 CONTENT SEL** (1501)	Default: 103 (Parameter 0103 OUPUT FREQ) Range: 99 - 178	
	AO1 CONTENT MIN (1502)	Default: Depends on the signal selected with Parameter 1501. Range:	
	AO1 CONTENT MAX (1503)	Default: Depends on the signal selected with Parameter 1501. Range: -	
	MINIMUM AO1 (1504)	Default: 0.0mA Range: 0.0 - 20.0mA	
	MAXIMUM AO1 (1505)	Default: 20.0mA Range: 0.0 - 20.0mA	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
ANALOG OUTPUTS (Continued)	**FILTER AO1** (1506)	Default: 0.0 s Range: 0.0 - 10.0 s	
	AO2 CONTENT SEL (1507)	Default: 104 (Parameter 0104 CURRENT) Range: 99 - 178	
	AO2 CONTENT MIN (1508)	Default: Depends on the signal selected with Parameter 1507. Range: -	
	AO2 CONTENT MAX (1509)	Default: Depends on the signal selected with Parameter 1507. Range: -	
	MINIMUM AO2 (1510)	Default: 0.0mA Range: 0.0 - 20.0mA	
	MAXIMUM AO2 (1511)	Default: 20.0mA Range: 0.0 - 20.0mA	
	FILTER AO2 (1512)	Default: 0.1 s Range: 0.0 - 10.0 s	
SYSTEM CONTROLS	**RUN ENABLE** (1601)	Default: 0 (NOT SEL) Range: -6 to 7	
	PARAMETER LOCK (1602)	Default: 1 (OPEN) Range: 0 - 2	
	PASS CODE (1603)	Default: 0 Range: 0 - 65535	
	FAULT RESET SEL (1604)	Default: 0 (KEYPAD) Range: -6 to 8	
	LOCAL LOCK (1606)	Default: 0 (NOT SEL) Range: -6 to 7	
	PARAM SAVE (1607)	Default: 0 (DONE) Range: 0 - 1	
	START ENABLE 1 (1608)	Default: 0 (NOT SEL) Range: -6 to 7	
	START ENABLE 2 (1609)	Default: 0 (NOT SEL) Range: -6 to 7	
	DISPLAY ALARMS (1610)	Default: 0 (NO) Range: 0 - 1	
LIMITS	**MINIMUM SPEED** (2001)	Default: 0 RPM Range: -30000 to 30000 RPM	
	MAXIMUM SPEED (2002)	Default: -01: 1500 RPM/-U1: 1800 RPM Range: 0 to 30000 RPM	
	MAX CURRENT (2003)	Default: $1.8 \cdot /_{2hd}$ Range: 0 - $1.8 \cdot /_{2hd}$	
	OVERVOLT CTRL (2005)	Default: 1 (ENABLE) Range: 0 - 1	
	UNDERVOLT CTRL (2006)	Default: 1 [ENABLE (TIME)] Range: 0 - 2	
	MINIMUM FREQ (2007)	Default: 0.0 Hz Range: -500.0 to 500.0 Hz	
	MAXIMUM FREQ (2008)	Default: 60.0 (62.0) Hz Range: 0.0 to 500.0 Hz	
	MIN TORQUE 1 (2015)	Default: -300.0% Range: -600.0 to 0.0%	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
START/STOP	**MAX TORQUE 1** (2017)	Default: 300.0% Range: 0.0 to 600.0	
	START FUNCTION (2101)	Default: 8 (RAMP) Range: 0.0 to 600.0	
	STOP FUNCTION (2102)	Default: 1 (COAST) Range: 1 - 2	
	DC MAGN TIME (2103)	Default: 0.30 s Range: 0.00 - 10.00 s	
	DC HOLD CTL (2104)	Default: 0 (NOT SEL) Range: 0 - 2	
	DC HOLD SPEED (2105)	Default: 5 RPM Range: 0 - 360 RPM	
	DC CURR REF (2106)	Default: 30% Range: 0 - 100%	
	DC BRAKE TIME (2107)	Default: 0.0 s Range: 0.0 - 250.0 s	
	START INHIBIT (2108)	Default: 0 (OFF) Range: 0 - 1	
	EMERG STOP SEL (2109)	Default: 0 (NOT SEL) Range: -6 to 6	
	TORQ BOOST CURR (2110)	Default: 100% Range: 15 - 300%	
	ZERO SPEED DELAY (2112)	Default: 0.0 s (NOT SEL) Range: 0.0 s, 0.1 s - 60.0 s	
	START DELAY (2113)	Default: 0.00 s Range: 0.00 s - 60.00 s	
ACCEL/DECEL	**ACC/DEC 1/2 SEL** (2201)	Default: 5 (DI5) Range: -6 to 7	
	ACCELER TIME 1 (2202)	Default: 5.0 s Range: 0.0 - 1800.0 s	
	DECELER TIME 1 (2203)	Default: 5.0 s Range: 0.0 - 1800.0 s	
	RAMP SHAPE 1 (2204)	Default: 0.0 s Range: 0.0 = LINEAR, 0.1 to 1000.0 s	
	ACCELER TIME 2 (2205)	Default: 60.0 s Range: 0.0 - 1800.0 s	
	DECELER TIME 2 (2206)	Default: 60.0 s Range: 0.0 - 1800.0 s	
	RAMP SHAPE 2 (2207)	Default: 0.0 s Range: 0.0 = LINEAR, 0.1 to 1000.0 s	
	EMERG DEC TIME (2208)	Default: 1.0 s Range: 0.0 - 1800.0 s	
	RAMP INPUT 0 (2209)	Default: 0 (NOT SEL) Range: -6 to 7	
SPEED CONTROL	**PROP GAIN** (2301)	Default: 5.00 Range: 0.00 - 200.00	
	INTEGRATION TIME (2302)	Default: 0.50 s Range: 0.00 - 600.00 s	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
SPEED CONTROL (Continued)	**DERIVATION TIME** (2303)	Default: 0 ms Range: 0 - 10000 ms	
	ACC COMPENSATION (2304)	Default: 0.00 s Range: 0.00 - 600.00 s	
	AUTOTUNE RUN (2305)	Default: 0 (OFF) Range: 0 - 1	
CRITICAL SPEEDS	**CRIT SPEED SEL** (2501)	Default: 0 (OFF) Range: 0 - 1	
	CRIT SPEED 1 LO (2502)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	CRIT SPEED 1 HI (2503)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	CRIT SPEED 2 LO (2504)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	CRIT SPEED 2 HI (2505)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	CRIT SPEED 3 LO (2506)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	CRIT SPEED 3 HI (2507)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
MOTOR CONTROL	**FLUX OPT ENABLE** (2601)	Default: 0 (OFF) Range: 0 - 1	
	FLUX BRAKING (2602)	Default: 0 (OFF) Range: 0 - 1	
	IR COMP VOLT (2603)	Default: Size Dependent Range: 0.0 - 100.0 V	
	IR COMP FREQ (2604)	Default: 80% Range: 0 - 100%	
	U/F RATIO (2605)	Default: 1 (LINEAR) Range: 1 - 2	
	SWITCHING FREQ (2606)	Default: 4 kHz Range: 1, 2, 4, 8, 12 kHz	
	SWITCH FREQ CTRL (2607)	Default: 1 (ON) Range: 0 - 1	
	SLIP COMP RATIO (2608)	Default: 0% Range: 0 - 200%	
	NOISE SMOOTHING (2609)	Default: 0 (DISABLE) Range: 0 - 1	
	DC STABILIZER (2619)	Default: 0 (DISABLE) Range: 0 - 1	
FAULT FUNCTIONS	**AI<MIN FUNCTION** (3001)	Default: 0 (NOT SEL) Range: 0 - 3	
	PANEL COMM ERR (3002)	Default: 1 (FAULT) Range: 1 - 3	
	EXTERNAL FAULT 1 (3003)	Default: 0 (NOT SEL) Range: -6 to 6	
	EXTERNAL FAULT 2 (3004)	Default: 0 (NOT SEL) Range: -6 to 6	
	MOT THERM PROT (3005)	Default: 1 (FAULT) Range: 1 - 2	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
FAULT FUNCTIONS (Continued)	**MOT THERM TIME** (3006)	Default: 500 s Range: 256 - 9999 s	
	MOT LOAD CURVE (3007)	Default: 100% Range: 50 - 150%	
	ZERO SPEED LOAD (3008)	Default: 70% Range: 25 - 150%	
	BREAK POINT FREQ (3009)	Default: 35 Hz Range: 1 - 250 Hz	
	STALL FUNCTION (3010)	Default: 0 (NOT SEL) Range: 0 - 2	
	STALL FREQUENCY (3011)	Default: 20.0 Hz Range: 0.5 - 50.0 Hz	
	STALL TIME (3012)	Default: 20 s Range: 10 - 400 s	
	EARTH FAULT (3017)	Default: 1 (ENABLE) Range: 0 - 1	
	COMM FAULT FUNC (3018)	Default: 0 (NOT SEL) Range: 0 - 3	
	COMM FAULT TIME (3019)	Default: 3.0 s Range: 0.0 - 600.0 s	
	AI1 FAULT LIMIT (3021)	Default: 0.0% Range: 0.0 - 100.0%	
	AI2 FAULT LIMIT (3022)	Default: 0.0% Range: 0.0 - 100.0%	
	WIRING FAULT (3023)	Default: 1 (ENABLE) Range: 0 - 1	
	CB TEMP FAULT (3024)	Default: 1 (ENABLE) Range: 0 - 1	
AUTOMATIC RESET	**NUMBER OF TRIALS** (3101)	Default: 0 Range: 0 - 5	
	TRIAL TIME (3102)	Default: 30.0 s Range: 1.0 - 600.0 s	
	DELAY TIME (3103)	Default: 0.0 s Range: 0.0 - 120.0 s	
	AR OVERCURRENT (3104)	Default: 0 (DISABLE) Range: 0 - 1	
	AR OVERVOLTAGE (3105)	Default: 0 (DISABLE) Range: 0 - 1	
	AR UNDERVOLTAGE (3106)	Default: 0 (DISABLE) Range: 0 - 1	
	AR AI<MIN (3107)	Default: 0 (DISABLE) Range: 0 - 1	
	AR EXTERNAL FLT (3108)	Default: 0 (DISABLE) Range: 0 - 1	
SUPERVISION	**SUPERV 1 PARAM** (3201)	Default: 103 (Parameter 0103 OUTPUT FREQ) Range: 100 = NOT SELECTED, 101 - 178	
	SUPERV 1 LIM LO (3202)	Default: Depends on the signal selected with par. 3201 Range:	
	SUPERV 1 LIM HI (3203)	Default: Depends on the signal selected with par. 3201 Range:	
	SUPERV 2 PARAM (3204)	Default: 104 (Parameter 0104 CURRENT) Range: 100 = NOT SELECTED, 101 - 178	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
SUPERVISION (Continued)	**SUPERV 2 LIM HI** (3206)	Default: Depends on the signal selected with par. 3204 Range:	
	SUPERV 3 PARAM (3207)	Default: 105 (Parameter 0105 TORQUE) Range: 100 = NOT SELECTED, 101 - 178	
	SUPERV 3 LIM LO (3208)	Default: Depends on the signal selected with par. 3207 Range:	
	SUPERV 3 LIM HI (3209)	Default: Depends on the signal selected with par. 3207 Range:	
INFORMATION	**FIRMWARE** (3301)	Default: Firmware version Range: 0000 - FFFF hex	
	LOADING PACKAGE (3302)	Default: Type dependent Range: 0000 - FFFF hex	
	TEST DATE (3303)	Default: Range: yy.ww	
	DRIVE RATING (3304)	Default: Type dependent Range:	
	PARAMETER TABLE (3305)	Default: Type dependent Range: 0000 - FFFF hex	
		Contains the version of the parameter table used in the drive.	
PANEL DISPLAY	**SIGNAL1 PARAM** (3401)	Default: 103 (Parameter 0103 OUTPUT FREQ) Range: 100 = NOT SELECTED, 101 - 178	
	SIGNAL1 MIN (3402)	Default: Depends on the signal selected with par. 3401 Range:	
	SIGNAL1 MAX (3403)	Default: Depends on the signal selected with par. 3401 Range:	
	OUTPUT1 DSP FORM (3404)	Default: 9 (DIRECT) Range: 0 - 9	
	OUTPUT1 UNIT (3405)	Default: Depends on the signal selected with par. 3401 Range: 0 - 127	
	OUTPUT1 MIN (3406)	Default: Depends on the signal selected with par. 3401 Range: -	
	OUTPUT1 MAX (3407)	Default: Depends on the signal selected with par. 3401 Range: -	
	SIGNAL2 PARAM (3408)	Default: 104 (Parameter 0104 CURRENT) Range: 100 = NOT SELECTED, 101 - 178	
	SIGNAL2 MIN (3409)	Default: Depends on the signal selected with par. 3408 Range: -	
	SIGNAL2 MAX (3410)	Default: Depends on the signal selected with par. 3408 Range: -	
	OUTPUT2 DSP FORM (3411)	Default: 9 (DIRECT) Range: 0 - 9	
	OUTPUT2 UNIT (3412)	Default: Depends on the signal selected with par. 3408 Range: 0 - 127	
	OUTPUT2 MIN (3413)	Default: Depends on the signal selected with par. 3408 Range: -	
	OUTPUT2 MAX (3414)	Default: Depends on the signal selected with par. 3408 Range: -	
	SIGNAL3 PARAM (3415)	Default: 105 (Parameter 0105 TORQUE) Range: 100 = NOT SELECTED, 101 - 178	
	SIGNAL3 MIN (3416)	Default: Depends on the signal selected with par. 3415 Range:	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
PANEL DISPLAY (Continued)	**SIGNAL3 MAX** (3417)	Default: Depends on the signal selected with par. 3415 Range:	
	OUTPUT3 DSP FORM (3418)	Default: 9 (DIRECT) Range: 0 - 9	
	OUTPUT3 UNIT (3419)	Default: Depends on the signal selected with par. 3415 Range: 0 - 127	
	OUTPUT3 MIN (3420)	Default: Depends on the signal selected with par. 3415 Range:	
	OUTPUT3 MAX (3421)	Default: Depends on the signal selected with par. 3415 Range:	
MOTOR TEMP MEAS	**SENSOR TYPE** (3501)	Default: 0 (NONE) Range: 0 - 6	
	INPUT SELECTION (3502)	Default: 1 (AI1) Range: 1 - 8	
	ALARM LIMIT (3503)	Default: 110°C / 1500 ohm / 0 Range: Par. 3501 = 1 to 3: -10 to 200°C Par. 3501 = 4: 0 to 5000 ohm Par. 3501 = 5 to 6: 0 to 1	
	FAULT LIMIT (3504)	Default: 130°C / 4000 ohm / 0 Range: Par. 3501 = 1 to 3: -10 to 200°C Par. 3501 = 4: 0 to 5000 ohm Par. 3501 = 5 to 6: 0 to 1	
USER LOAD CURVE	**USER LOAD C MODE** (3701)	Default: 0 (NOT SEL) Range: 0 - 3	
	USER LOAD C FUNC (3702)	Default: 1 (FAULT) Range: 1 - 2	
	USER LOAD C TIME (3703)	Default: 20 s Range: 10 - 400 s	
	LOAD FREQ 1 (3704)	Default: 5 Hz Range: 0 - 500 Hz	
	LOAD TORQ LOW 1 (3705)	Default: 10% Range: 0 - 600%	
	LOAD TORQ HIGH 1 (3706)	Default: 300% Range: 0 - 600%	
	LOAD FREQ 2 (3707)	Default: 25 Hz Range: 0 - 500 Hz	
	LOAD TORQ LOW 2 (3708)	Default: 15% Range: 0 - 600%	
	LOAD TORQ HIGH 2 (3709)	Default: 300% Range: 0 - 600%	
	LOAD FREQ 3 (3710)	Default: 43 Hz Range: 0 - 500 Hz	
	LOAD TORQ LOW 3 (3711)	Default: 25% Range: 0 - 600%	
	LOAD TORQ HIGH 3 (3712)	Default: 300% Range: 0 - 600%	
	LOAD FREQ 4 (3713)	Default: 50 Hz Range: 0 - 500 Hz	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
USER LOAD CURVE (Continued)	**LOAD TORQ LOW 4** (3714)	Default: 30% Range: 0 - 600%	
	LOAD TORQ HIGH 4 (3715)	Default: 300% Range: 0 - 600%	
	LOAD FREQ 5 (3716)	Default: 500 Hz Range: 0 - 500 Hz	
	LOAD TORQ LOW 5 (3717)	Default: 30% Range: 0 - 600%	
	LOAD TORQ HIGH 5 (3718)	Default: 300% Range: 0 - 600%	
PROCESS PID SET 1	**GAIN** (4001)	Default: 1.0 Range: 0.1 - 100.0	
	INTEGRATION TIME (4002)	Default: 60.0 s Range: 0.0 = (NOT SEL), 0.1 - 3600.0 s	
	DERIVATION TIME (4003)	Default: 0.0 s Range: 0.0 - 10.0 s	
	PID DERIV FILTER (4004)	Default: 1.0 s Range: 0.0 - 10.0 s	
	ERROR VALUE INV (4005)	Default: 0 (NO) Range: 0 - 1	
	UNITS (4006)	Default: 4 (%) Range: 0 - 127	
	UNIT SCALE (4007)	Default: 1 Range: 0 - 4	
	0% VALUE (4008)	Default: 0.0 Range: Unit and scale defined by par. 4006 and 4007	
	100% VALUE (4009)	Default: 100.0 Range: Unit and scale defined by par. 4006 and 4007	
	SET POINT SEL (4010)	Default: (1) AI1 Range: 0 - 2, 8 - 17, 19	
	INTERNAL SETPNT (4011)	Default: 40.0 Range: Unit and scale defined by par. 4006 and 4007	
	SETPOINT MIN (4012)	Default: 0.0% Range: -500.0 to 500.0	
	SETPOINT MAX (4013)	Default: 100.0% Range: -500.0 to 500.0	
	FBK SEL (4014)	Default: 1 (ACT1) Range: 1 - 13	
	FBK MULTIPLIER (4015)	Default: 0.000 (NOT SEL) Range: 0.000 = (NOT SEL), -32.768 to 32.767	
	ACT1 INPUT (4016)	Default: 2 (AI2) Range: 1 - 7	
	ACT2 INPUT (4017)	Default: 2 (AI2) Range: 1 - 7	
	ACT1 MINIMUM (4018)	Default: 0% Range: -1000 to 1000%	
	ACT1 MAXIMUM (4019)	Default: 100% Range: -1000 to 1000%	
	ACT2 MINIMUM (4020)	Default: 0% Range: -1000 to 1000%	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
PROCESS PID SET 1 (Continued)	**ACT2 MAXIMUM** (4021)	Default: 100% Range: -1000 to 1000%	
	SLEEP SELECTION (4022)	Default: 0 (NOT SEL) Range: -6 to 7	
	PID SLEEP LEVEL (4023)	Default: 0.0 Hz / 0 RPM Range: 0.0 - 500.0 Hz / 0 - 30000 RPM	
	PID SLEEP DELAY (4024)	Default: 60.0 s Range: 0.0 - 3600.0 s	
	WAKE-UP DEV (4025)	Default: 0.0s Range: Unit and scale defined by par. 4006 and 4007	
	WAKE-UP DELAY (4026)	Default: 0.50 s Range: 0.0 - 60.00 s	
ENERGY SAVING	**ENERGY PRICE** (4502)	Default: 0.00 Range: 0.00 - 655.35	
	CO2 CONV FACTOR (4507)	Default: 0.5 tn/MWh Range: 0.00 - 10.0 tn/MWh	
	PUMP POWER (4508)	Default: 100.0% Range: 0.0 - 1000.0%	
	ENERGY RESET (4509)	Default: 0 (DONE) Range: 0 - 1	
EXT COMM MODULE	**FBA TYPE** (5101)	Default: READ ONLY Range: -	
	FB PAR 2 - FB PAR 26 (5102 - 5126)	Default: 0 Range: 0 - 65535	
	FBA PAR REFRESH (5127)	Default: 0 (DONE) Range: 0 - 1	
	FILE CPI FW REV (5128)	Default: READ ONLY Range: -	
	FILE CONFIG ID (5129)	Default: READ ONLY Range: -	
	FILE CONFIG REV (5130)	Default: READ ONLY Range: -	
	FBA STATUS (5131)	Default: READ ONLY Range: -	
	FBA CPI FW REV (5132)	Default: READ ONLY Range: -	
	FBA APPL FW REV (5133)	Default: READ ONLY Range: -	
PANEL COMM	**STATION ID** (5201)	Default: 1 Range: 1 - 247	
	BAUD RATE (5202)	Default: 9.6 kbits/s Range: 9.6, 19.2, 38.4, 57.6, 115.2 kbits/s	
	PARITY (5203)	Default: 0 (8 NONE 1) Range: 0 - 3	
	OK MESSAGES (5204)	Default: READ ONLY Range: -	
	PARITY ERRORS (5205)	Default: READ ONLY Range: -	
	FRAME ERRORS (5206)	Default: READ ONLY Range: -	
	BUFFER OVERRUNS (5207)	Default: READ ONLY Range: -	
	CRC ERRORS (5208)	Default: READ ONLY Range: -	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
EFB PROTOCOL	**EFB PROTOCOL ID** (5301)	Default: 0 Range: 0 - 0 x FFFF	
	EFB STATION ID (5302)	Default: 1 Range: 0 - 65535	
	EFB BAUD RATE (5303)	Default: 9.6 kbits/s Range: 1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6, 76.8 kbits/s	
	EFB PARITY (5304)	Default: 0 (8 NONE 1) Range: 0 - 3	
	EFB CTRL PROFILE (5305)	Default: 0 (ABB DRV LIM) Range: 0 - 2	
	EFB OK MESSAGES (5306)	Default: READ ONLY Range: -	
	EFB CRC ERRORS (5307)	Default: READ ONLY Range: -	
	EFB UART ERRORS (5308)	Default: READ ONLY Range: -	
	EFB STATUS (5309)	Default: READ ONLY Range: -	
	EFB PAR 10 (5310)	Default: 0 Range: 0 - 65535	
	EFB PAR 11 (5311)	Default: 0 Range: 0 - 65535	
	EFB PAR 12 (5312)	Default: 0 Range: 0 - 65535	
	EFB PAR 13 (5313)	Default: 0 Range: 0 - 65535	
	EFB PAR 14 (5314)	Default: 0 Range: 0 - 65535	
	EFB PAR 15 (5315)	Default: 0 Range: 0 - 65535	
	EFB PAR 16 (5316)	Default: 0 Range: 0 - 65535	
	EFB PAR 17 (5317)	Default: 0 Range: 0 - 65535	
	EFB PAR 18 (5318)	Default: 0 Range: 0 - 65535	
	EFB PAR 19 (5319)	Default: 0 Range: 0000 - FFFF hex	
	EFB PAR 20 (5320)	Default: 0 Range: 0000 - FFFF hex	
LOAD ANALYZER	**PVL SIGNAL** (6401)	Default: 103 (parameter 0103 OUTPUT FREQ) Range: 100 - 178	
	PVL FILTER TIME (6402)	Default: 0.1 s Range: 0.0 - 120.0 s	
	LOGGERS RESET (6403)	Default: 0 (NOT SEL) Range: -6 to 7	
	AL2 SIGNAL (6404)	Default: 103 (parameter 0103 OUTPUT FREQ) Range: 100 - 178	
	AL2 SIGNAL BASE (6405)	Default: Depends on the signal selected with par. 6404 Range:	
	PEAK VALUE (6406)	Default: Range:	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
LOAD ANALYZER (Continued)	**PEAK TIME 1** (6407)	Default: Range: Date dd.mm.yy / power-on time in days	
	PEAK TIME 2 (6408)	Default: Range: Time hh.mm.ss	
	CURRENT AT PEAK (6409)	Default: Range: 0.0 - 6553.5 A	
	UDC AT PEAK (6410)	Default: Range: 0 - 65535 V	
	FREQ AT PEAK (6411)	Default: Range: 0.0 - 6553.5 Hz	
	TIME OF RESET 1 (6412)	Default: Range: Date dd.mm.yy / power-on time in days	
	TIME OF RESET 2 (6413)	Default: Range: Time hh.mm.ss	
	AL1RANGE0TO10 (6414)	Default: Range: 0.0 - 100.0%	
	AL1RANGE10TO20 (6415)	Default: Range: 0.0 - 100.0%	
	AL1RANGE20TO30 (6416)	Default: Range: 0.0 - 100.0%	
	AL1RANGE30TO40 (6417)	Default: Range: 0.0 - 100.0%	
	AL1RANGE40TO50 (6418)	Default: Range: 0.0 - 100.0%	
	AL1RANGE50TO60 (6419)	Default: Range: 0.0 - 100.0%	
	AL1RANGE60TO70 (6420)	Default: Range: 0.0 - 100.0%	
	AL1RANGE70TO80 (6421)	Default: Range: 0.0 - 100.0%	
	AL1RANGE80TO90 (6422)	Default: Range: 0.0 - 100.0%	
	AL1RANGE90TO (6423)	Default: Range: 0.0 - 100.0%	
	AL2RANGE0TO10 (6424)	Default: Range: 0.0 - 100.0%	
	AL2RANGE10TO20 (6425)	Default: Range: 0.0 - 100.0%	
	AL2RANGE20TO30 (6426)	Default: Range: 0.0 - 100.0%	
	AL2RANGE30TO40 (6427)	Default: Range: 0.0 - 100.0%	
	AL2RANGE40TO50 (6428)	Default: Range: 0.0 - 100.0%	
	AL2RANGE50TO60 (6429)	Default: Range: 0.0 - 100.0%	
	AL2RANGE60TO70 (6430)	Default: Range: 0.0 - 100.0%	
	AL2RANGE70TO80 (6431)	Default: Range: 0.0 - 100.0%	
	AL2RANGE80TO90 (6432)	Default: Range: 0.0 - 100.0%	

Group	Parameter (Number) Selection (Value)	Parameter Name and Description	User Setting
OPTIONS	**AL2RANGE90TO** (6433)	Default: Range: 0.0 - 100.0%	
	COMM PROT SEL (9802)	Default: 0 (NOT SEL) Range: 0, 1, 4	

Chapter C
CE Guidelines

C.1 IEC/EN 61800-3 (2004) Definitions

EMC stands for Electromagnetic Compatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

First environment includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes.

Second environment includes establishments connected to a network not directly supplying domestic premises.

Drive of category C2: drive of rated voltage less than 1000 V and intended to be installed and commissioned only by a professional when used in the first environment.

Note: A professional is a person or organization having necessary skills in installing and/or commissioning power drive systems, including their EMC aspects.

Category C2 has the same EMC emission limits as the earlier class first environment restricted distribution. EMC standard IEC/EN 61800-3 does not any more restrict the distribution of the drive, but the using, installation and commissioning are defined.

Drive of category C3: drive of rated voltage less than 1000 V, intended for use in the second environment and not intended for use in the first environment.

Category C3 has the same EMC emission limits as the earlier class second environment unrestricted distribution.

C.2 Compliance with the IEC/EN 61800-3 (2004)

The immunity performance of the drive complies with the demands of IEC/ EN 61800-3, category C2 (see page 305 for IEC/ EN 61800-3 definitions). The emission limits of IEC/EN 61800-3 are complied with the provisions described below.

C.2.1 First environment (drives of category C2)

1. The internal EMC filter is connected.
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. The motor cable length does not exceed the allowed maximum length specified in section Motor cable length for 400 V drives on page 284 for the frame size and switching frequency in use.

WARNING! In a domestic environment, this product may cause radio inference, in which case supplementary mitigation measures may be required.

C.2.2 Second environment (drives of category C3)

1. The internal EMC filter is connected.
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. The motor cable length does not exceed the allowed maximum length specified in section Motor cable length for 400 V drives on page 284 for the frame size and switching frequency in use.

Note: It is not allowed to install a drive with the internal EMC filter connected on IT (ungrounded) systems. The supply network becomes connected to ground potential through the EMC filter capacitors, which may cause danger or damage the drive.

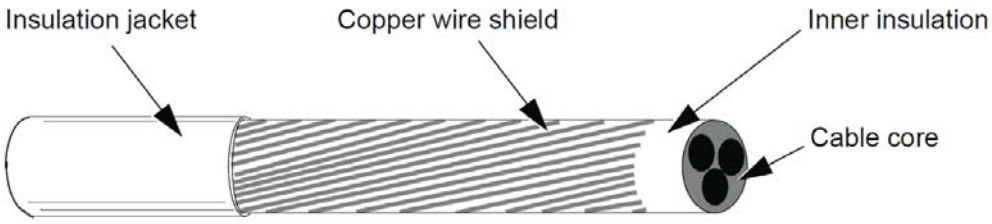
Note: It is not allowed to install a drive with the internal EMC filter connected to a corner grounded TN system as this would damage the drive.

C.3 Motor cable requirements for CE & C-Tick compliance

The requirements in this section apply for CE or C-Tick compliance.

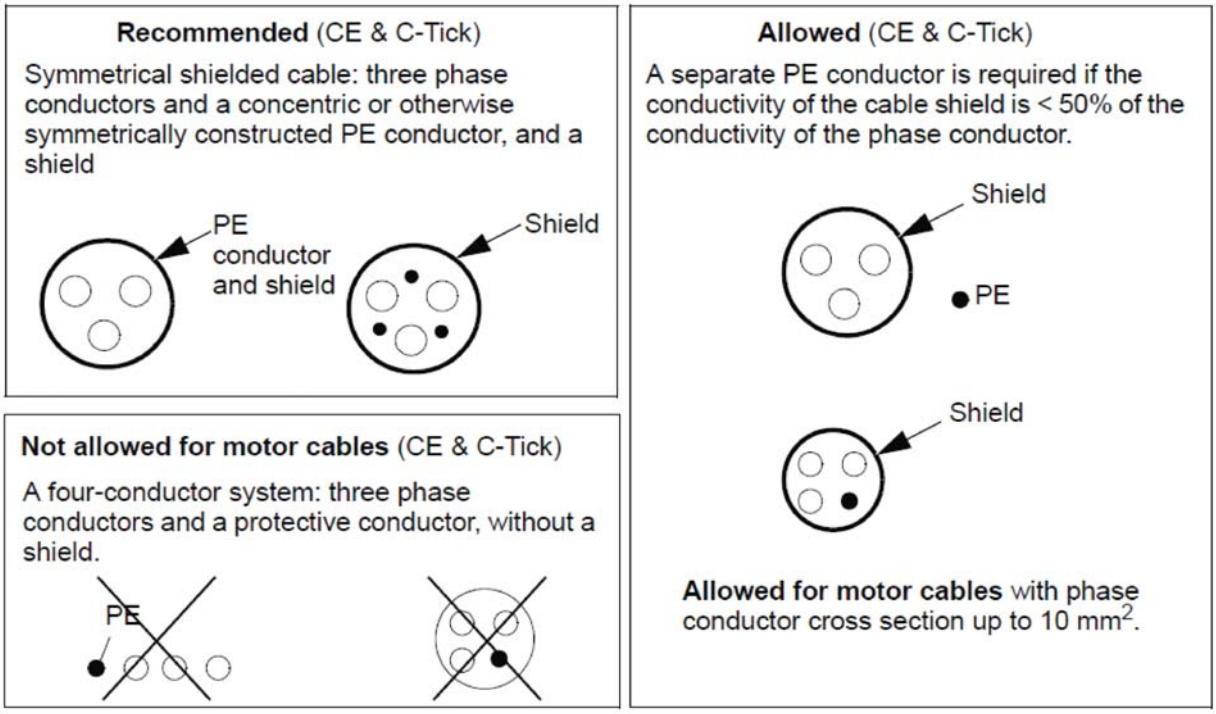
C.3.1 Minimum requirement (CE & C-Tick)

The motor cable must be a symmetrical three conductor cable with a concentric PE conductor or a four conductor cable with a concentric shield, however, a symmetrical constructed PE conductor is always recommended. The following figure shows the minimum requirement for the motor cable shield (for example, MCMK, Draka NK Cables).



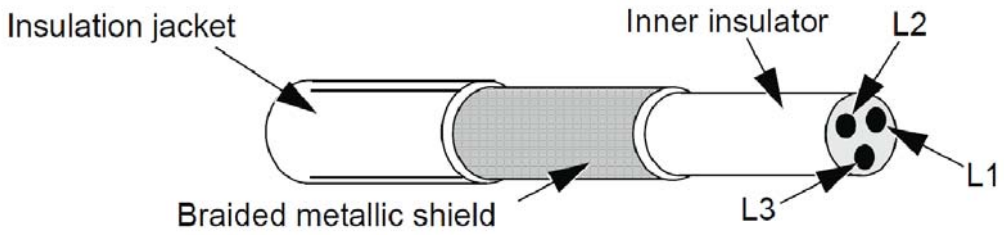
C.3.2 Recommendation for conductor layout

The following figure compares conductor layout features in motor cables.


Recommended (CE & C-Tick)
Symmetrical shielded cable: three phase conductors and a concentric or otherwise symmetrically constructed PE conductor, and a shield
PE conductor and shield
Shield
Not allowed for motor cables (CE & C-Tick)
A four-conductor system: three phase conductors and a protective conductor, without a shield.
PE
Allowed (CE & C-Tick)
A separate PE conductor is required if the conductivity of the cable shield is < 50% of the conductivity of the phase conductor.
Shield
PE
Shield
Allowed for motor cables with phase conductor cross section up to 10 mm2.

C.3.3 Effective motor cable shields

The general rule for cable shield effectiveness is: the better and tighter the cable's shield, the lower the radiated emission level. The following figure shows an example of an effective construction (for example Ölflex-Servo-FD 780 CP, Lappkabel or MCCMK, NK Cables).



C.3.4 EN 61800-3 compliant motor cables

The most efficient EMC filtering can be achieved by following these rules:
- Motor cables must have an effective shield as described in section Effective motor cable shields.
- Motor cable shield wires must be twisted together into a bundle (pig-tail) – the bundle length must be less than five times its width – and connected to the terminal marked (at the bottom right-hand corner of the drive).
- At the motor end, the motor cable shield must be earthed 360 degrees with an EMC cable gland, or the shield wires must be twisted together into a bundle (pigtail) not longer than five times its width and connected to the PE terminal of the motor.
- See section Motor cable length for 400 V drives, columns “EMC limits” to check the maximum motor cable lengths and the need for filters for 400 V drives for IEC/EN 61800-3 compliance.

WARNING! Do not use RFI/EMC filters on IT systems.

C.4 Product protection in the USA

This product is protected by one or more of the following US patents:

4,920,306	5,301,085	5,463,302	5,521,483	5,532,568	5,589,754
5,612,604	5,654,624	5,799,805	5,940,286	5,942,874	5,952,613
6,094,364	6,147,887	6,175,256	6,184,740	6,195,274	6,229,356
6,252,436	6,265,724	6,305,464	6,313,599	6,316,896	6,335,607
6,370,049	6,396,236	6,448,735	6,498,452	6,552,510	6,597,148
6,600,290	6,741,059	6,774,758	6,844,794	6,856,502	6,859,374
6,922,883	6,940,253	6,934,169	6,956,352	6,958,923	6,967,453
6,972,976	6,977,449	6,984,958	6,985,371	6,992,908	6,999,329
7,023,160	7,034,510	7,036,223	7,045,987	7,057,908	7,059,390
7,067,997	7,082,374	7,084,604	7,098,623	7,102,325	7,109,780
7,164,562	7,176,779	7,190,599	7,215,099	7,221,152	7,227,325
7,245,197	7,250,739	7,262,577	7,271,505	7,274,573	7,279,802
7,280,938	7,330,095	7,349,814	7,352,220	7,365,622	7,372,696
7,388,765	D503,931	D510,319	D510,320	D511,137	D511,150
D512,026	D512,696	D521,466	D541,743S	D541,744S	D541,745S
D548,182S	D548,183S				

Other patents pending.

Chapter D
Options and Kits

D.1 Options and Kits for the ACB530

Several standard Options & Kits are available for the ACB530.

These include I/O Options, Keypad Mounting Kits, Flange (heat sink out) Mounting Kits and Communication Options.

D.2 Optional Equipment and Accessories

D.2.1 Option

Option	Part Number	Description
115/230V Digital Input Interface	OHDI-01	The 115/230V Digital Input Interface module offers six (6) 115V or three (3) 230V rated relays mounted on a common board used to drive DI1 through DI6 of the ACB530. The 115/230V must be provided by the user."
Cabinet Keypad Mounting	OPMP-01	Control Panel Mounting Platform allows remote mounting of the keypad on a large enclosure or remote panel. The kit maintains UL Type 12 integrity of the mounting location. Adapters, 3 m (10ft) cable and mounting hardware are included in this kit. With this mounting arrangement, the keypad is removable from the panel in a fashion identical to a drive-mounted keypad.
Keypad Extension Cable	OCAT-01	7 foot CAT 5 patch cable allows remote operation of the standard panel or connection of the drive to a Personal Computer using the RJ45/DB9 Adapter which must be purchased separately.
Control Keypad Mounting	ACS/H-CP-EXT	Control Panel Mounting Kit for ACB530 drives allows remote mounting of the ACB530 keypad on the door of an enclosure. The kit includes a 10 ft (3 m) CAT 5 patch cable, gasket for NEMA 12, mounting hardware and drilling template.
NEMA 4X Cabinet Keypad Mounting	ACS/H-CP-EXT-IP66	Allows remote mounting of the ACB-CP-BA Operator Panels on a larger NEMA 4X (IP66) enclosure or remote panel. The kit maintains NEMA 4X integrity of the mounting location. All necessary hardware and a mounting template are provided in addition to a 3 m panel cable. When mounted, the operator is not removable from the front of the enclosure. The operator panel must be purchased separately.
DeviceNet Adapter	RDNA-01	The DeviceNet network uses a linear bus topology. Terminating resistors are required on each end of the trunk line. Drop lines as long as 6 meters (20 feet) each are permitted, allowing one or more nodes to be attached. DeviceNet allows branching structures only on drop lines.
Profibus-DP Adapter	RPBA-01	PROFIBUS is an open serial communication standard that enables data exchange between all kinds of automation components. The physical transmission medium of the bus is a twisted pair cable (according to the RS-485 standard). The maximum length of the bus cable is 100 to 1200 meters, depending on the selected transmission rate. Up to 31 stations can be connected to the same PROFIBUS system without the use of repeaters.
EtherCAT Adapter	RECA-01	The RECA-01 module supports EtherCAT® network protocol. EtherCAT® is a Real Time Ethernet technology which aims to maximize the use of the full duplex Ethernet bandwidth. It overcomes the overhead normally associated with Ethernet by employing “on the fly” processing hardware. An EtherCAT® bus consists of a master system and up to 65535 slave devices, connected together with standard Ethernet cabling. The RECA-01 supports 10/100 Mbps transfer rate with network connections made with CAT 5 wiring and RJ-45 connectors. Designed for daisy chain configuration on an EtherCAT® network.

Option	Part Number	Description
Ethernet Adapter	RETA-01	The RETA-01 Adapter module supports the Modbus/TCP and EtherNet/IP network protocols. Modbus/TCP is a variant of the Modbus family of simple, vendor-neutral communication protocols intended for supervision and control of automation equipment. The implementation of the Modbus/TCP server in the RETA-01 module is done according to the Modbus/TCP Specification 1.0. The Modbus/TCP protocol allows the RETA-01 module to be used as an Ethernet bridge to control the drive. The RETA-01 module supports eight simultaneous IP connections. Ethernet/IP is based on the Common Industrial Protocol (CIP), which is also the framework for both the ControlNet and DeviceNet networks. Ethernet/IP uses standard Ethernet and TCP/IP technology to transport CIP communication packets. The module fulfills all requirements for certification as an Ethernet/IP device.
Ethernet Adapter	RETA-02	The RETA-02 Adapter module supports the Modbus/TCP and PROFINET IO network protocols. Modbus/TCP is a variant of the Modbus family of simple, vendor neutral communication protocols intended for supervision and control of automation equipment. Specifically, it covers the use of Modbus messaging in an Ethernet environment using the TCP/IP protocols. The implementation of the Modbus/TCP server in the RETA-02 module is done according to the Modbus/TCP Specification 1.0. The Modbus/TCP protocol allows the RETA-02 module to be used as an Ethernet bridge to control the drive. The RETA-02 module supports eight simultaneous IP connections. PROFINET IO uses traditional Ethernet hardware and software to define a network that structures the task of exchanging data, alarms and diagnostics with Programmable Controllers and other automation controllers. PROFINET IO can be thought as PROFIBUS on Ethernet. PROFINET IO uses two different communication channels to exchange data with programmable controllers and other devices. The standard TCP/IP channel is used for parameterization, configuration and acyclic read/write operations. The RT or Real Overview Time channel is used for standard cyclic data transfer and alarms. There is no theoretical limit for the amount of connected nodes in PROFINET IO network, but in practice, the programmable controllers and number of available network addresses limits the size. The PROFINET IO protocol is specified in the IEC standards 61158 and 61784. The communication with a drive is specified in the PROFIdrive profile (v4) published by PROFIBUS INTERNATIONAL.
ControlNet Adapter	RCNA-01	The ControlNet network uses an RG-6 quad shielded cable or fibre with support for media redundancy. The RCNA-01 Adapter module supports only RG-6 quad shielded cable (coax) for the bus connection. ControlNet is flexible in topology options (bus, tree, star) to meet various application needs. The fieldbus speed is 5 Mbits/s. The RCNA-01 ControlNet Adapter module can not originate connections on its own, but a scanner node can open a connection towards it. The ControlNet protocol is implemented according to the ControlNet International specification for a Communication adapter.
Flange Mounting Kits	FMK-A-R1	Flange Mounting Kits for the ACB530 drives allows mounting the drive with the heatsink external to a 3rd party enclosure. Use of the flange kit requires removal of the drive cover, reducing protection to IP00. R1 through R4 flange kits can be used with 3rd party UL Type 1 & 12 (NEMA 1 & 12) enclosures. R5 and R6 kits provide NEMA 1 protection only.
	FMK-A-R2	
	FMK-A-R3	
	FMK-A-R4	
	AC8-FLNGMT-R5	
	AC8-FLNGMT-R6	

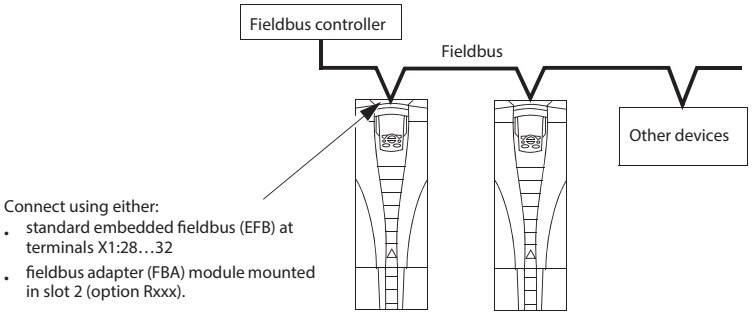
Chapter EAppendix E
Fieldbus Communications

E.1 What This Chapter Contains

The chapter describes how the drive can be controlled by external devices over a communication network using embedded fieldbus.

E.2 Overview

The ACB530 can be set up to accept control from an external system using standard serial communication protocols. When using serial communication, the ACB530 can either:
- receive all of its control information from the fieldbus, or
- be controlled from some combination of fieldbus control and other available control locations, such as digital or analog inputs and the control panel.


Fieldbus controller
Fieldbus
Other devices
Connect using either:
standard embedded fieldbus (EFB) at terminals X1:28…32
fieldbus adapter (FBA) module mounted in slot 2 (option Rxxx).

Two basic serial communications configurations are available:
- embedded fieldbus (EFB) – Using the RS485 interface at terminals X1:28…32 on the control board, a control system can communicate with the drive using the Modbus® protocol.
- fieldbus adapter (FBA)

E.2.1 Control interface

In general, the basic control interface between Modbus and the drive consists of:

•Output words
  – Control Word
  – Reference1
  – Reference2

•Input words
  – Status Word
  – Actual value 1
  – Actual value 2
  – Actual value 3
  – Actual value 4
  – Actual value 5
  – Actual value 6
  – Actual value 7
  – Actual value 8

E.3 Planning

Network planning should address the following questions:
1. What types and quantities of devices must be connected to the network?
2. What control information must be sent down to the drives?
3. What feedback information must be sent from the drives to the controlling system?

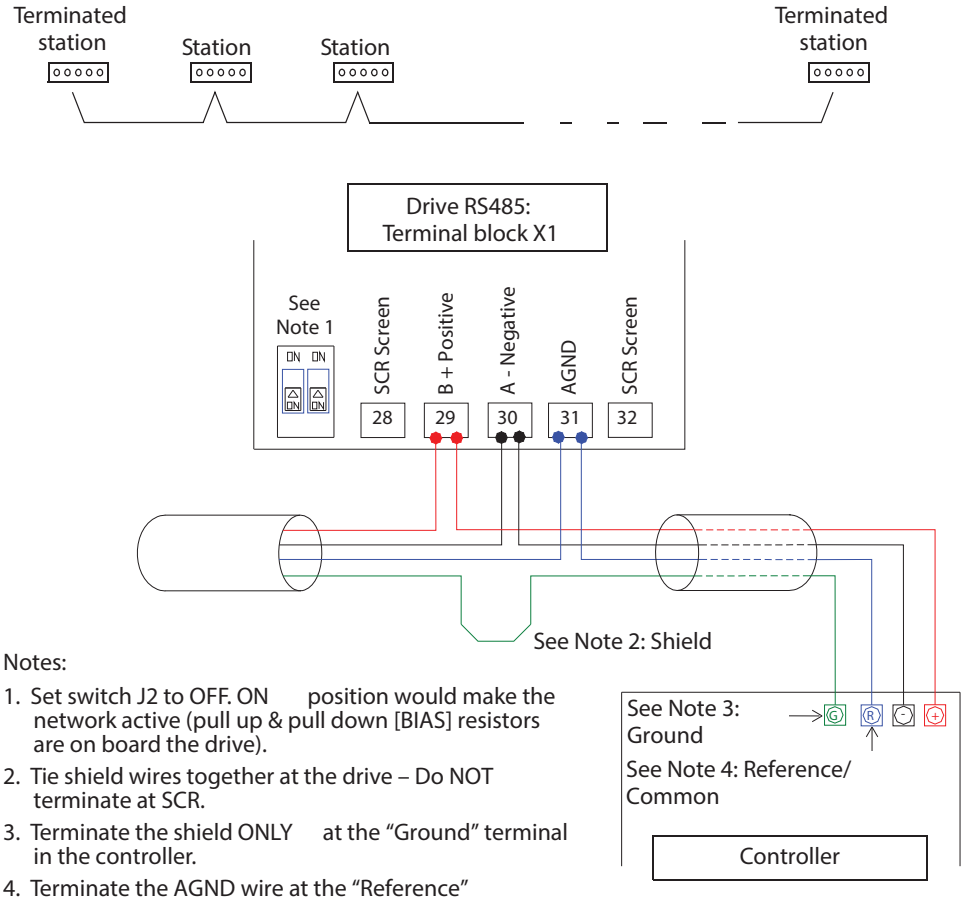
E.4 Mechanical and Electrical Installation - EFB

WARNING! Connections should be made only while the drive is disconnected from the power source.

Drive Terminals 28 - 32 are for RS485 communications.

- Use Belden 9842 or equivalent. Belden 9842 is a dual twisted, shielded pair cable with a wave impedance of 120 ohm.
- Use one of these twisted shielded pairs for the RS485 link. Use this pair to connect all A (-) terminals together and all B (+) terminals together.
- Use one of the wires in the other pair for the logical ground (terminal 31), leaving one wire unused.
- Do not directly ground the RS485 network at any point. Ground all devices on the network using their corresponding terminals.
- As always, the grounding wires should not form any closed loops, and all the devices should be earthed to a common ground.
- Connect the RS485 link in a daisy-chained bus, as indicated in Figure E-1 below.
- To reduce noise on the network, terminate the RS485 network using 120 Ω resistors at both ends of the network. Use the DIP switch to connect or disconnect the termination resistors. See figure E-1.

Figure E-1 Installation



Notes:

1. Set switch J2 to OFF. ON position would make the network active (pull up & pull down [BIAS] resistors are on board the drive).
2. Tie shield wires together at the drive – Do NOT terminate at SCR.
3. Terminate the shield ONLY at the "Ground" terminal in the controller.
4. Terminate the AGND wire at the "Reference" terminal in the controller.

E.5 Communication Set-Up - EFB

E.5.1 Serial Communication Selection

To activate the serial communication, set parameter 9802 COMM PROT SEL = 1 (STD MODBUS).

NOTE: If you cannot see the desired selection on the keypad, your drive does not have the protocol software in the application memory. Contact Baldor for assistance.

E.5.2 Serial Communication Configuration

Setting 9802 automatically sets the appropriate default values in parameters that define the communication process. These parameters and descriptions are defined below. Note that the station ID may require adjustment.

Code	Description	Protocol Reference - Modbus
5301	EFB PROTOCOL ID Contains the indentification and program revision of the protocol.	Do not edit. Any non-zero value entered for parameter 9802 COMM PROT SEL, sets this parameter automatically. The format is XXYY, where XX = protocal ID, and YY = program revision.
5302	EFB STATION ID Defines the station ID address of the RS485 link. No two stations on the line may have the same address.	Set each drive on the network with a unique value for this parameter. When this protocol is selected, the default value for this parameter is 1.
	NOTE: For a new address to take effect, the drive power must be cycled or 5302 must first be set to 0 before selecting a new address. Leaving 5302 = 0 places the RS485 channel in reset, disabling communication.	
5303	EFB BAUD RATE Defines the communication speed of the RS485 link in kbits per second (kbits/s). 1.2 kbit/s 9.6 kbit/s 57.6 kbit/s 2.4 kbit/s 19.2 kbit/s 115.2kbit/s 4.8 kbit/s 38.4 kbit/s	When this protocol is selected, the default value for this parameter is 9.6.
5304	EFB PARITY Defines the data length, parity and stop bits to be used with the RS485 communication. • The same settings must be used in all on-line stations. 0 = 8 NONE 1-8 data bits, no parity, one stop bit. 1 = 8 NONE 2-8 data bits, no parity, two stop bits. 2 = 8 EVEN 1-8 data bits, even parity, one stop bit. 3 = 8 ODD 1-8 data bits, odd parity, one stop bit.	When this protocol is selected, the default value for this parameter is 1.
5305	EFB CTRL PROFILE Selects the communication profile used by the EFB protocol. 0 = ABB DRV LIM - Operation of Control/Status Words conforms to ABB Drives Profile, as used in ACS400. 1 = DCU PROFILE - Operation of Control/Status Words conforms to 32-bit DCU Profile. 2 = ABB DRV FULL - Operation of Control/Status Words conforms to ABB Drives Profile, as used in ACS600/800.	When this protocol is selected, the default value for this parameter is 0.

NOTE: After any changes to the communication settings, the protocol must be reactivated by either cycling the drive power, or by clearing and then restoring the station ID (5302).

E.6 Activate Drive Control Functions - EFB

E.6.1 Controlling the Drive

Fieldbus Control of various drive functions requires configuration to:
- tell the drive to accept fieldbus control of the function
- define as a fieldbus input, any drive data required for control
- define as a fieldbus output, any control data required by the drive

The following sections describe, at a general level, the configuration required for each control function. For the protocol-specific details, see the document supplied with the FBA module.

E.6.2 Start/Stop Direction Control

Using the fieldbus for start/stop/direction control of the drive requires:
- drive parameter values set as defined below
- fieldbus controller supplied command(s) in the appropriate location (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive Parameter	Value	Decription	Modbus[1] Protocol Reference	
			ABB DRV	DCU
1001 EXT1 COMMAND S	10 (COMM)	Start/Stop by fieldbus with Ext1 selected.	40001 bits 0 - 3	40031 bits 0, 1
1002 EXT2 COMMAND S	10 (COMM)	Start/Stop by fieldbus with Ext2 selected.	40001 bits 0 - 3	40031 bits 0, 1
1003 DIRECTION	3 (REQUEST)	Direction by fieldbus.	4002/4003[2]	40031 bit 3

1. For Modbus, the protocol reference can depend on the profile used, hence two columns in these tables. One column refers to the ABB Drive profile, selected when parameter 5305 = 0 (ABB DRV LIM) or 5305 = 2 (ABB DRV FULL). The other column refers to the DCU profile selected when parameter 5305 = 1 (DCU PROFILE).
2. The reference provides direction control - a negative reference provides reverse rotation.

E.6.3 Input Reference Select

Using the fieldbus to provide input references to the drive requires:
- drive parameter values set as defined below
- fieldbus controller supplied command(s) in the appropriate location (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive Parameter	Value	Decription	Modbus Protocol Reference	
			ABB DRV	DCU
1102 EXT1/EXT2 SEL	8 (COMM)	Reference set selection by fieldbus.	40001 bit 11	40031 bit 5
1103 REF1 SELECT	8 (COMM)	Input reference 1 by fieldbus.	40002	
1106 REF2 SELECT	8 (COMM)	Input reference 2 by fieldbus.	40003	

E.6.3.1 Reference Scaling

Where required, REFERENCES can be scaled. See Modbus Register 40002 for more information.

E.6.4 Miscellaneous Drive Control

Using the fieldbus for miscellaneous drive control requires:
- drive parameter values set as defined below
- fieldbus controller supplied command(s) in the appropriate location (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive Parameter	Value	Decription	Modbus Protocol Reference	
			ABB DRV	DCU
1601 RUN ENABLE	7 (COMM)	Run enable by fieldbus.	40001 bit 3	40031 bit 6
1604 FAULT RESET SEL	8 (COMM)	Fault reset through by fieldbus.	40001 bit 7	40031 bit 4
1606 LOCAL LOCK	8 (COMM)	Source for local lock selection is the fieldbus.	-	40031 bit 14
1607 PARAM SAVE	1 (SAVE)	Saves altered parameters to memory (than value returns to 0).	41607	
1608 START ENABLE 1	7 (COMM)	Source for start enable 1 is the fieldbus Command word.	-	40032 bit 2
1609 START ENABLE 2	7 (COMM)	Source for start enable 2 is the fieldbus Command word.	-	40032 bit 3
2013 MIN TORQUE SEL	7 (COMM)	Source for minimum torque selection is the fieldbus.	-	40031 bit 15
2014 MAX TORQUE SEL	7 (COMM)	Source for maximum torque selection is the fieldbus.	-	40031 bit 15
2201 ACC/DEC 1/2 SEL	7 (COMM)	Source for ramp pair selection is the fieldbus.	-	40031 bit 10

E.6.5 Relay Output Control

Using the fieldbus for miscellaneous drive control requires:
- drive parameter values set as defined below
- fieldbus controller supplied command(s) in the appropriate location (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive Parameter		Value	Decription	Modbus Protocol Reference	
				ABB DRV	DCU
1401	RELAY OUTPUT 1	35 (COMM)	Relay Output 1 controlled by fieldbus.	40134 bit 0 or 0000033	
1402	RELAY OUTPUT 2	35 (COMM)	Relay Output 2 controlled by fieldbus.	40134 bit 1 or 0000034	
1403	RELAY OUTPUT 3	35 (COMM)	Relay Output 3 controlled by fieldbus.	40134 bit 2 or 0000035	
1410[1]	RELAY OUTPUT 4	35 (COMM)	Relay Output 4 controlled by fieldbus.	40134 bit 3 or 0000036	
1411[1]	RELAY OUTPUT 5	35 (COMM)	Relay Output 5 controlled by fieldbus.	40134 bit 4 or 0000037	
1412[1]	RELAY OUTPUT 6	35 (COMM)	Relay Output 6 controlled by fieldbus.	40134 bit 5 or 0000038	

1. More than 3 relays requires the addition of a relay extension module.

NOTE: Relay Status Feedback occurs without configuration as defined below.

Drive Parameter	Decription	Modbus Protocol Reference	
		ABB DRV	DCU
0122	Relay 1 -3 status.	40122	
0123	Relay 4 - 6 status.	40123	

E.6.6 Analog Output Control

Using the fieldbus for miscellaneous drive control requires:
- drive parameter values set as defined below
- fieldbus controller supplied command(s) in the appropriate location (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive Parameter		Value	Decription	Modbus Protocol Reference	
				ABB DRV	DCU
1501	AO1 CONTENT SEL	135 (COMM VALUE 1)	Analog Output 1 controlled by writing to parameter 0136.	-	
0135	COMM VALUE 1	-		40135	
1507	AO2 CONTENT SEL	136 (COMM VALUE 2)	Analog Output 2 controlled by writing to parameter 0136.	-	
0136	COMM VALUE 2	-		40136	

E.6.7 PID Control Setpoint Source

Use the following settings to select the fieldbus as the setpoint source for PID loops:

Drive Parameter		Value	Decription	Modbus Protocol Reference	
				ABB DRV	DCU
4010	SET POINT SEL (Set 1)	8 (COMM VALUE 1) 9 (COMM +AI1) 10 (COMM*AI1)	Setpoint is input reference 2 (+/-/* AI1)	40003	
4110	SET POINT SEL (Set 2)				
4210	SET POINT SEL (Ext/Trim)				

E.6.8 Communication Fault

When using the fieldbus control, specify the drive's action if serial communication is lost.

Drive Parameter		Value	Decription
3018	COMM FAULT FUNC	0 (NOT SEL) 1 (FAULT) 2 (CONST SP7) 3 (LAST SPEED)	Set for appropriate drive response.
3019	COMM FAULT TIME	Set time delay before acting on a communication loss.	

E.7 Information from the drive - EFB

E.7.1 Pre-defined Feedback

Inputs to the controller (drive outputs) have pre-defined meanings established by the protocol. Obtaining information from the drive does not require drive configuration. The following table lists a sample of data.

Drive Parameter		Modbus Protocol Reference	
		ABB DRV	DCU
0102	SPEED	40102	
0103	OUTPUT FREQ	40103	
0104	CURRENT	40104	
0105	TORQUE	40105	
0106	POWER	40106	
0107	DC BUS VOLTAGE	40107	
0109	OUTPUT VOLTAGE	40109	
0301	FB CMD WORD1 - bit 0 (STOP)	40301 bit 0	
0301	FB CMD WORD1 1 - bit 2 (REV)	40301 bit 2	
0118	DI 1-3 STATUS - bit 0 (DI3)	40118	

NOTE: With Modbus, any parameter can be accessed using the format: "4" followed by the parameter number.

E.7.2 Actual Value Scaling

The scaling of actual values can be protocol dependent. For actual values, scale the integer using the parameter's resolution. The following table shows an example.

Feedback Integer	Parameter Resolution	(Feedback Integer) • (Parameter resolution) = Scaled Value
1	0.1 mA	1 • 0.1 mA = 0.1 mA
10	0.1%	10 • 0.1% = 1%

When parameters are in percent, the complete parameter description specifies what parameter corresponds to 100%. In such cases, to convert from percent to engineering units, multiply by the value of the parameter that defines 100% and divide by 100%. The following table shows an example.

Integer Value Read from Drive	Parameter Resolution	Value of the Parameter that defines 100%	(Integer Value) • (Parameter resolution) • (Value of 100% Ref) / 100% = Scaled Value
10	0.1%	1500 rpm[1]	10 • 0.1% • 1500 RPM/ 100% = 15 RPM
100	0.1%	500 Hz[2]	100 • 0.1% • 500 RPM/ 100% = 50 Hz

1. Assumes that the actual value uses parameter 9908 MOT NOM SPEED as the 100% reference and that 9908 = 1500 rpm.
2. Assumes that the actual value uses parameter 9907 MOT NOM FREQ as the 100% reference and that 9907 = 500 Hz.

E.8 Diagnostics - EFB

E.8.1 Fault Queue for Drive Diagnostics

The three most recent ACB530 faults are reported to the fieldbus as defined below.

Drive Parameter		Modbus Protocol Reference	
		ABB DRV	DCU
0401	LAST FAULT	40401	
0412	PREVIOUS FAULT 1	40412	
0413	PREVIOUS FAULT 2	40413	

E.8.2 Serial Communication Diagnostics

Network problems can be caused by multiple sources. Some of these sources are:
- loose connections
- incorrect wiring (including swapped wires)
- bad grounding
- duplicate station numbers
- incorrect setup of drives or other devices on the network

The major diagnostic features for fault tracing on an EFB network include EFB Protocol parameters 5306 - 5309.

E.8.3 Diagnostic situations

The sub-sections below describe various diagnostic situations – the problem symptoms and corrective actions.

Normal operation
During normal network operation, 5306…5309 parameter values act as follows at each drive:
- 5306 EFB OK MESSAGES advances (advances for each message properly received and addressed to this drive).
- 5307 EFB CRC ERRORS does not advance at all (advances when an invalid message CRC is received).
- 5308 EFB UART ERRORS does not advance at all (advances when character format errors are detected, such as parity or framing errors).
- 5309 EFB STATUS value varies depending on network traffic.

Loss of communication
If communication is lost, parameters 3018 COMM FAULT FUNC and 3019 COMM FAULT TIME can be used to reconfigure the ACB530.

No master station on line
If no master station is on line: Neither the EFB OK MESSAGES nor the errors (5307 EFB CRC ERRORS and 5308 EFB UART ERRORS) increase on any of the stations. To correct:
- Check that a network master is connected and properly programmed on the network.
- Verify that the cable is connected and that it is not cut or short circuited.

Duplicate stations
If two or more stations have duplicate numbers:
- Two or more drives cannot be addressed.
- Every time there is a read or write to one particular station, the value for 5307 EFB CRC ERRORS or 5308 EFB UART ERRORS advances.

To correct: Verify the station numbers of all stations. Change conflicting station numbers.

Swapped wires
If the communication wires are swapped (terminal A on one drive is connected to terminal B on another):
- The value of 5306 EFB OK MESSAGES does not advance.
- The values of 5307 EFB CRC ERRORS and 5308 EFB UART ERRORS are advancing.

To correct: Check that the RS-485 lines are not swapped.

Fault 28 – Serial 1 Err
If the drive's control panel shows fault code 28, SERIAL 1 ERR, check for either of the following:
- The master system is down. To correct, resolve problem with master system.
- The communication connection is bad. To correct, check communication connection at the drive.
- The time-out selection for the drive is too short for the given installation. The master is not polling the drive within the specified time-out delay.

To correct, increase the time set by parameter 3019 COMM FAULT TIME.

Intermittent off-line occurrences
The problems described above are the most common problems encountered with ACB530 serial communication. Intermittent problems might also be caused by:
- marginally loose connections
- wear on wires caused by equipment vibrations
- insufficient grounding and shielding on both the devices and on the communication cables.

E.9 Modbus Protocol Technical Data

E.9.1 Overview

The Modbus® protocol was introduced by Modicon, Inc. for use in control environments featuring Modicon programmable controllers. Due to its ease of use and implementation, this common PLC language was quickly adopted as a de-facto standard for integration of a wide variety of master controllers and slave devices.

Modbus is a serial, asynchronous protocol. Transactions are half-duplex, featuring a single Master controlling one or more Slaves. While RS232 can be used for point-to-point communication between a single Master and a single Slave, a more common implementation features a multi-drop RS485 network with a single Master controlling multiple Slaves. The ACB530 features RS485 for its Modbus physical interface.

RTU
The Modbus specification defines two distinct transmission modes: ASCII and RTU. The ACB530 supports RTU only.

Feature summary
The following Modbus function codes are supported by the ACB530.

Function	Code (Hex)	Additional information
Read Coil Status	0x01	Read discrete output status. For the ACB530, the individual bits of the control word are mapped to Coils 1…16. Relay outputs are mapped sequentially beginning with Coil 33 (e.g. RO1=Coil 33).
Read Discrete Input Status	0x02	Read discrete inputs status. For the ACB530, the individual bits of the status word are mapped to Inputs 1…16 or 1…32, depending on the active profile. Terminal inputs are mapped sequentially beginning with Input 33 (e.g. DI1=Input 33).
Read Multiple Holding Registers	0x03	Read multiple holding registers. For the ACB530, the entire parameter set is mapped as holding registers, as well as command, status and reference values.
Read Multiple Input Registers	0x04	Read multiple input registers. For the ACB530, the 2 analog input channels are mapped as input registers 1 & 2.
Force Single Coil	0x05	Write a single discrete output. For the ACB530, the individual bits of the control word are mapped to Coils 1…16. Relay outputs are mapped sequentially beginning with Coil 33 (e.g. RO1=Coil 33).
Write Single Holding Register	0x06	Write single holding register. For the ACB530, the entire parameter set is mapped as holding registers, as well as command, status and reference values.
Diagnostics	0x08	Perform Modbus diagnostics. Subcodes for Query (0x00), Restart (0x01) & Listen Only (0x04) are supported.
Force Multiple Coils	0x0F	Write multiple discrete outputs. For the ACB530, the individual bits of the control word are mapped to Coils 1…16. Relay outputs are mapped sequentially beginning with Coil 33 (e.g. RO1=Coil 33).
Write Multiple Holding Registers	0x10	Write multiple holding registers. For the ACB530, the entire parameter set is mapped as holding registers, as well as command, status and reference values.
Read/Write Multiple Holding Registers	0x17	This function combines functions 0x03 and 0x10 into a single command.

Mapping Summary
The following table summarizes the mapping between the ACB530 (parameters and I/0) and Modbus reference space.

ACB530	Modbus Reference	Supported Function Codes
• Contrast Bits • Relay Outputs	Coils (0xxxx)	• 01 - Read Coil Status • 05 - Force Single Coil • 15 - Force Multiple Coils
• Status Bits • Discrete Inputs	Discrete Inputs (1xxxx)	• 02 - Read Input Status
• Analog Inputs	Input Registers (3xxxx)	• 04 - Read Input Registers
• Parameters • Control/Status Words • References	Holding Registers (4xxxx)	• 03 - Read 4X Registers • 06 - Preset Single 4X Register • 18 - Preset Multiple 4X Registers • 23 - Read/Write 4X Registers

Communication profiles
When communicating by Modbus, the ACB530 supports multiple profiles for control and status information. Parameter 5305 EFB CTRL PROFILE selects the profile used.

- ABB DRV LIM – The primary (and default) profile is the ABB DRV LIM profile. This implementation of the ABB Drives profile standardizes the control interface with ACS400 drives. The ABB Drives profile is based on the PROFIBUS interface. It is discussed in detail in the following sections.
- DCU PROFILE – The DCU PROFILE profile extends the control and status interface to 32 bits. It is the internal interface between the main drive application and the embedded fieldbus environment.
- ABB DRV FULL – ABB DRV FULL is the implementation of the ABB Drives profile that standardizes the control interface with ACS600 and ACS800 drives. This implementation supports two control word bits not supported by the ABB DRV LIM implementation.

E.9.2 Modbus addressing

With Modbus, each function code implies access to a specific Modbus reference set. Thus, the leading digit is not included in the address field of a Modbus message.

Note: The ACB530 supports the zero-based addressing of the Modbus specification. Holding register 40002 is addressed as 0001 in a Modbus message. Similarly, coil 33 is addressed as 0032 in a Modbus message.

Refer again to the Mapping summary above. The following sections describe, in detail, the mapping to each Modbus reference set.

E.9.2.1 0xxxx Mapping – Modbus coils

The drive maps the following information to the 0xxxx Modbus set called Modbus Coils:

- bit-wise map of the CONTROL WORD (selected using parameter 5305 EFB CTRL PROFILE). The first 32 coils are reserved for this purpose.
- relay output states, numbered sequentially beginning with coil 00033.

The following table summarizes the 0xxxx reference set:

Modbus Reference	Internal Location (All Profiles)	ABB DRV LIM (5305 = 0)	ABB DRV LIM (5305 = 0)	ABB DRV FULL (5305 = 2)
00001	CONTROL WORD - Bit 0	OFF1[1]	STOP	OFF1[1]
00002	CONTROL WORD - Bit 1	OFF2[1]	START	OFF2[1]
00003	CONTROL WORD - Bit 2	OFF3[1]	REVERSE	OFF3[1]
00004	CONTROL WORD - Bit 3	START	LOCAL	START
00005	CONTROL WORD - Bit 4	N/A	RESET	RAMP_OUT_ZERO[1]
00006	CONTROL WORD - Bit 5	RAMP_HOLD[1]	EXT2	RAMP_HOLD[1]
00007	CONTROL WORD - Bit 6	RAMP_IN_ZERO[1]	RUN_DISABLE	RAMP_IN_ZERO[1]
00008	CONTROL WORD - Bit 7	RESET	STPMODE_R	RESET
00009	CONTROL WORD - Bit 8	N/A	STPMODE_EM	N/A
00010	CONTROL WORD - Bit 9	N/A	STPMODE_C	N/A
00011	CONTROL WORD - Bit 10	N/A	RAMP_2	REMOTE_CMD[1]
00012	CONTROL WORD - Bit 11	EXT2	RAMP_OUT_0	EXT2
00013	CONTROL WORD - Bit 12	N/A	RAMP_HOLD	N/A
00014	CONTROL WORD - Bit 13	N/A	RAMP_IN_0	N/A
00015	CONTROL WORD - Bit 14	N/A	REQ_LOCALLOCK	N/A
00016	CONTROL WORD - Bit 15	N/A	TORQLIM2	N/A
00017	CONTROL WORD - Bit 16	Does not apply	FBLOCAL_CTL	Does not apply
00018	CONTROL WORD - Bit 17		FBLOCAL_REF	
00019	CONTROL WORD - Bit 18		START_DISABLE1	
00020	CONTROL WORD - Bit 19		START_DISABLE2	
00021 - 00032	RESERVED	Reserved	Reserved	Reserved
00033	RELAY OUTPUT 1	Relay Output 1	Relay Output 1	Relay Output 1
00034	RELAY OUTPUT 2	Relay Output 2	Relay Output 2	Relay Output 2
00035	RELAY OUTPUT 3	Relay Output 3	Relay Output 3	Relay Output 3
00036	RELAY OUTPUT 4	Relay Output 4	Relay Output 4	Relay Output 4
00037	RELAY OUTPUT 5	Relay Output 5	Relay Output 5	Relay Output 5
00038	RELAY OUTPUT 6	Relay Output 6	Relay Output 6	Relay Output 6

1. Active Low

For the 0xxxx registers:

- Status is always readable.
- Forcing is allowed by user configuration of the drive for fieldbus control.
- Additional relay outputs are added sequentially.

The ACB530 supports the following Modbus function codes for coils:

Function Code	Description
01	Read Coil status
05	Force single coil
15 (0x0F Hex)	Force multiple coils

E.9.2.2 1xxxx Mapping – Modbus discrete inputs

The drive maps the following information to the 1xxxx Modbus set called Modbus Discrete Inputs:

- bit-wise map of the STATUS WORD (selected using parameter 5305 EFB CTRL PROFILE). The first 32 inputs are reserved for this purpose.
- discrete hardware inputs, numbered sequentially beginning with input 33.

The following table summarizes the 1xxxx reference set:

Modbus Reference	Internal Location (All Profiles)	ABB DRV (5305 = 0 OR 2)	DCU PROFILE (5305 = 1)
10001	STATUS WORD - Bit 0	RDY_ON	READY
10002	STATUS WORD - Bit 1	RDY_RUN	ENABLED
10003	STATUS WORD - Bit 2	RDY_REF	STARTED
10004	STATUS WORD - Bit 3	TRIPPED	RUNNING
10005	STATUS WORD - Bit 4	OFF_2_STA[1]	ZERO_SPEED
10006	STATUS WORD - Bit 5	OFF_3_STA[1]	ACCELERATE
10007	STATUS WORD - Bit 6	SWC_ON_INHIB	DECELERATE
10008	STATUS WORD - Bit 7	ALARM	AT_SETPOINT
10009	STATUS WORD - Bit 8	AT_SETPOINT	LIMIT
10010	STATUS WORD - Bit 9	REMOTE	SUPERVISION
10011	STATUS WORD - Bit 10	ABOVE_LIMIT	REV_REF
10012	STATUS WORD - Bit 11	EXT2	REV_ACT
10013	STATUS WORD - Bit 12	RUN_ENABLE	PANEL_LOCAL
10014	STATUS WORD - Bit 13	N/A	FIELDBUS_LOCAL
10015	STATUS WORD - Bit 14	N/A	EXT2_ACT
10016	STATUS WORD - Bit 15	N/A	FAULT
10017	STATUS WORD - Bit 16	Reserved	ALARM
10018	STATUS WORD - Bit 17	Reserved	REQ_MAINT
10019	STATUS WORD - Bit 18	Reserved	DIRLOCK
10020	STATUS WORD - Bit 19	Reserved	LOCALLOCK
10021	STATUS WORD - Bit 20	Reserved	CTL_MODE
10022	STATUS WORD - Bit 21	Reserved	Reserved
10023	STATUS WORD - Bit 22	Reserved	Reserved
10024	STATUS WORD - Bit 23	Reserved	Reserved
10025	STATUS WORD - Bit 24	Reserved	Reserved
10026	STATUS WORD - Bit 25	Reserved	Reserved
10027	STATUS WORD - Bit 26	Reserved	Reserved
10028	STATUS WORD - Bit 27	Reserved	REQ_REF1
10029	STATUS WORD - Bit 28	Reserved	REQ_REF2
10030	STATUS WORD - Bit 29	Reserved	REQ_REF2EXT
10031	STATUS WORD - Bit 30	Reserved	ACK_STARTINH
10032	STATUS WORD - Bit 31	Reserved	ACK_OFF_ILCK
00033	DI1	DI1	DI1
00034	DI2	DI2	DI2
00035	DI3	DI3	DI3
00036	DI4	DI4	DI4
00037	DI5	DI5	DI5
00038	DI6	DI6	DI6

1. Active Low

For the 1xxxx registers:
• Additional discrete inputs are added sequentially.

The ACB530 supports the following Modbus function codes for discrete inputs:

Function Code	Description
02	Read input status

E.9.2.3 3xxxx Mapping – Modbus inputs.

The drive maps the following information to the 3xxxx Modbus addresses called Modbus input registers:
• any user defined analog inputs.
The following table summarizes the input registers:

Modbus Reference	ACB530 All Profiles	Remarks
30001	AI1	This register shall report the level of Analog Input 1 (0 - 100%).
30002	AI2	This register shall report the level of Analog Input 2 (0 - 100%).

The ACB530 supports the following Modbus function codes for 3xxxx registers:

Function Code	Description
04	Read 3xxxx input status

E.9.2.4 4xxxx Register mapping

The drive maps its parameters and other data to the 4xxxx holding registers as follows:
• 40001…40099 map to drive control and actual values. These registers are described in the table below.
• 40101…49999 map to drive parameters 0101…9999. Register addresses that do not correspond to drive parameters are invalid. If there is an attempt to read or write outside the parameter addresses, the Modbus interface returns an exception code to the controller

The following table summarizes the 4xxxx drive control registers 40001…40099 (for 4xxxx registers above 40099, see the drive parameter list, e.g. 40102 is parameter 0102):

Modbus register		Access	Information
40001	Control word	R/W	Maps directly to the profile'S CONTROL WORD. Supported only if 5305 = 0 or 2 (ABB Drives profile). Parameter 5319 holds a copy in hex format.
40002	Reference 1	R/W	Range = 0…+20000 (scaled to 0…1105 REF1 MAX), or -20000…0 (scaled to 1105 REF1 MAX…0).
40003	Reference 2	R/W	Range = 0…+10000 (scaled to 0…1108 REF2 MAX), or -10000…0 (scaled to 1108 REF2 MAX…0).
40004	Status word	R	Maps directly to the profile'S STATUS WORD. Supported only if 5305 = 0 or 2 (ABB Drives profile). Parameter 5320 holds a copy in hex format.
40005	Actual 1 (select using 5310)	R	By default, stores a copy of 0103 OUTPUT FREQ. Use parameter 5310 to select a different actual value for this register.
40006	Actual 2 (select using 5311)	R	By default, stores a copy of 0104 CURRENT. Use parameter 5311 to select a different actual value for this register.
40007	Actual 3 (select using 5312)	R	By default, stores nothing. Use parameter 5312 to select an actual value for this register.
40008	Actual 4 (select using 5313)	R	By default, stores nothing. Use parameter 5313 to select an actual value for this register.
40009	Actual 5 (select using 5314)	R	By default, stores nothing. Use parameter 5314 to select an actual value for this register.
40010	Actual 6 (select using 5315)	R	By default, stores nothing. Use parameter 5315 to select an actual value for this register.
40011	Actual 7 (select using 5316)	R	By default, stores nothing. Use parameter 5316 to select an actual value for this register.
40012	Actual 8 (select using 5317)	R	By default, stores nothing. Use parameter 5317 to select an actual value for this register.
40031	Control word LSW	R/W	Maps directly to the Least Significant Word of the DCU profile's CONTROL WORD. Supported only if 5305 = 1. See parameter 0301.
40032	Control word MSW	R/W	Maps directly to the Most Significant Word of the DCU profile's CONTROL WORD. Supported only if 5305 = 1. See parameter 0302.

Modbus register		Access	Information
40033	Status word LSW	R	Maps directly to the Least Significant Word of the DCU profile‘s STATUS WORD. Supported only if 5305 = 1. See parameter 0303.
40034	ACS355 Status word MSW	R	Maps directly to the Most Significant Word of the DCU profile‘s STATUS WORD. Supported only if 5305 = 1. See parameter 0304.

For the Modbus protocol, drive parameters in EFB PROTOCOL report the parameter mapping to 4xxxx Registers.

Code	Description
5310	EFB PAR 10 - Specifies the parameter mapped to Modbus register 40005.
5311	EFB PAR 11 - Specifies the parameter mapped to Modbus register 40006.
5312	EFB PAR 12 - Specifies the parameter mapped to Modbus register 40007.
5313	EFB PAR 13 - Specifies the parameter mapped to Modbus register 40008.
5314	EFB PAR 14 - Specifies the parameter mapped to Modbus register 40009.
5315	EFB PAR 15 - Specifies the parameter mapped to Modbus register 40010.
5316	EFB PAR 16 - Specifies the parameter mapped to Modbus register 40011.
5317	EFB PAR 17 - Specifies the parameter mapped to Modbus register 40012.
5318	EFB PAR 18 - Sets additional delay in milliseconds before the ACB530 begins transmitting response to the master request.
5319	EFB PAR 19 - Holds a copy (in hex) of the CONTROL WORD, Modbus register 40001.
5320	EFB PAR 20 - Holds a copy (in hex) of the STATUS WORD, Modbus register 40004.

Except where restricted by the drive, all parameters are available for both reading and writing. The parameter writes are verified for the correct value and for a valid register addresses.

Note: Parameter writes through standard Modbus are always volatile i.e. modified values are not automatically stored to permanent memory. Use parameter 1607 PARAM SAVE to save all altered values.

The ACB530 supports the following Modbus function codes for 4xxxx registers:

Function Code	Description
03	Read holding 4xxxx registers
06	Preset single 4xxxx register
16 (0x10 Hex)	Preset multiple 4xxxx registers
23 (0x17 Hex)	Read/write 4xxxx registers

Actual values
The contents of the register addresses 40005…40012 are ACTUAL VALUES and are:
- specified using parameters 5310…5317
- Read-only values containing information on the operation of the drive
- 16-bit words containing a sign bit and a 15-bit integer
- when negative values, written as the two’s complement of the corresponding positive value
- scaled as described earlier in section Actual value scaling on page 207.

Exception codes
Exception codes are serial communication responses from the drive. The ACB530 supports the standard Modbus exception codes defined below.

Exception Code	Name	Meaning
01	ILLEGAL FUNCTION	Unsupported Command
02	ILLEGAL DATA ADDRESS	The data address received in the query is not allowable. It is not a defined, parameter/group.
03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for the ACB530, because it is one of the following: • Outside min. or max. limits. • Parameter is read-only. • Message is too long. • Parameter write not allowed when start is active. • Parameter write not allowed when factory macro is selected.

E.10 ABB control profiles technical data

E.10.1 Overview

ABB Drives profile
The ABB Drives profile provides a standard profile that can be used on multiple protocols, including Modbus and the protocols available via FBA modules. Two implementations of the ABB Drives profile are available:
- ABB DRV FULL – This implementation standardizes the control interface with ACS600 and ACS800 drives.
- ABB DRV LIM – This implementation standardizes the control interface with ACS400 drives. This implementation does not support two control word bits supported by ABB DRV FULL.

Except as noted, the following “ABB Drives Profile” descriptions apply to both implementations.

DCU profile
The DCU profile extends the control and status interface to 32 bits. It is the internal interface between the main drive application and the embedded fieldbus environment.

E.10.2 Control Word

The CONTROL WORD is the principal means for controlling the drive from a fieldbus system. The fieldbus master station sends the CONTROL WORD to the drive. The drive switches between states according to the bit-coded instructions in the CONTROL WORD. Using the CONTROL WORD requires that:
- The drive is in remote (REM) control.
- The serial communication channel is defined as the source for controlling commands (set using parameters such as 1001 EXT1 COMMANDS, 1002 EXT2 COMMANDS and 1102 EXT1/EXT2 SEL).
- The serial communication channel used is configured to use an ABB control profile. For example, to use the control profile ABB DRV FULL requires both parameter 9802 COMM PROT SEL = 1 (STD MODBUS) and parameter 5305 EFB CTRL PROFILE = 2 (ABB DRV FULL).

ABB Drives profile
The following table and the state diagram later in this sub-section describe the CONTROL WORD content for the ABB Drives profile.

ABB drives profile Control word, parameter 5319 EFB PAR 19				
Bit	**Name**	**Value**	**Commanded State**	**Comments**
0	OFF1 CONTROL	1	READY TO OPERATE	Enter READY TO OPERATE.
		0	EMERGENCY OFF	Drive ramps to stop according to currently active deceleration ramp (2203 or 2205). Normal command sequence: • Enter OFF1 ACTIVE • Proceed to READY TO SWITCH ON, unless other interlocks (OFF2, OFF3) are active.
1	OFF2 CONTROL	1	OPERATING	Continue operation (OFF2 inactive).
		0	EMERGENCY OFF	Drive coasts to stop. Normal command sequence: • Enter OFF2 ACTIVE • Proceed to SWITCHON INHIBITED
2	OFF3 CONTROL	1	OPERATING	Continue operation (OFF3 inactive).
		0	EMERGENCY STOP	Drive stops within time specified by parameter 2208. Normal command sequence: • Enter OFF3 ACTIVE • Proceed to SWITCH ON INHIBITED **WARNING! Ensure motor and driven machine can be stopped using this stop mode.**
3	INHIBIT OPERATION	1	OPERATION ENABLED	Enter OPERATION ENABLED. (Note: The Run enable signal must be active; see parameter 1601. If par. 1601 is set to COMM, this bit also activates the Run enable signal.)
		0	OPERATION INHIBITED	Inhibit operation. Enter OPERATION INHIBITED.
4	Note: Bit 4 is supported only by ABB DRV FULL profile.			
	RAMP_OUT_ ZERO (ABB DRV FULL)	1	NORMAL OPERATION	Enter RAMP FUNCTION GENERATOR: OUTPUT ENABLED.
		0	RFG OUT ZERO	Force Ramp function generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	RFG OUT ENABLED	Enable ramp function. Enter RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED.
		0	RFG OUT HOLD	Halt ramping (Ramp function generator output held).

ABB drives profile Control word, parameter 5319 EFB PAR 19				
Bit	**Name**	**Value**	**Commanded State**	**Comments**
6	RAMP_IN_ ZERO	1	RFG INPUT ENABLED	Normal operation. Enter OPERATING.
		0	RFG INPUT ZERO	Force Ramp function generator input to zero.
7	RESET	0=>1	RESET	Fault reset if an active fault exists. Enter SWITCH-ON INHIBITED. Effective if par. 1604 is set to COMM.
		0	OPERATING	Continue normal operation.
8 - 9	Not in use			
10	Note: Bit 10 is supported only by ABB DRV FULL.			
	REMOTE_CMD (ABB DRV FULL)	1		Fieldbus control enabled.
		0		• Control word ≠ 0 or reference ≠ 0: Retain last Control word and reference. • Control word = 0 and reference = 0: Fieldbus control enabled. • Reference decceleration/acceleration ramp are locked
11	EXT CTRL LOC	1	EXT2 SELECT	Select external control location EXT2. Effective if par. 1102 is set to COMM.
		0	EXT1 SELECT	0 Select external control location EXT1. Effective if par. 1102 is set to COMM.
12 - 15	Not in use			

DCU Profile

The following tables describe the Control word content for the DCU profile.

ADCU profile Control word, parameter 0301 FB CMD WORD 1				
Bit	**Name**	**Value**	**Command/Req**	**Information**
0	STOP	1	Stop	Stops according to either the stop mode parameter (2102) or the stop mode requests (bits 7 and 8). **Note:** Simultaneous STOP and START commands result in a stop command.
		0	(no op)	
1	START	1	Stop	
		0	(no op)	
2	REVERSE	1	Reverse direction	This bit XOR'd with the sign of the reference defines direction.
		0	Forward direction	
3	LOCAL	0…1	Local Mode	When the fieldbus sets this bit, it steals control and the drive moves to fieldbus local control mode.
		0	External Mode	
4	RESET	-> 1	Reset	Edge sensitive.
		other	(no op)	
5	EXT2	1	Switch to EXT2	
		0	Switch to EXT1	
6	RUN_DISABLE	1	Run disable	Inverted run enable.
		0	Run enable on	
7	STPMODE_R 1	1	Normal Ramp stop mode	
		0	(no op)	
8	STPMODE_EM 1	1	Emergency Ramp stop mode	
		0	(no op)	
9	STPMODE_C 1	1	Coast stop mode	
		0	(no op)	
10	RAMP_2	1	Ramp pair 2	
		0	Ramp pair 1	
11	RAMP_OUT_0	1	Ramp output to 0	
		0	(no op)	
12	RAMP_HOLD	1	Ramp freeze	
		0	(no op)	
13	RAMP_IN_0	1	Ramp input to 0	
		0	(no op)	

ADCU profile Control word, parameter 0301 FB CMD WORD 1				
Bit	**Name**	**Value**	**Command/Req**	**Information**
14	REQ_LOCALLOC	1	Local mode lock	In lock, drive will not switch to local mode.
		0	(no op)	
15	TORQLIM2	1	Torque limit pair 2	
		0	Torque limit pair 1	

DCU profile Control word, parameter 0302 FB CMD WORD 2				
Bit	**Name**	**Value**	**Command/Req**	**Information**
16 - 26	Reserved			
27	REF_CONST	1	Constant speed ref.	These bits are only for supervision purposes.
		0	(no op)	
28	REF_AVE	1	Average speed ref.	
		0	(no op)	
29	LINK_ON	1	Master is detected in link	
		0	LInk is down	
30	REQ_STARTINH	1	Start inhibit request is pending	
		0	Start inhibit request is OFF	
31	OFF_INTERLOCK	1	Panel OFF button pressed	For the control panel (or PC tool) this is the OFF button interlock.
		0	(no op)	

E.10.3 Status word

The contents of the STATUS WORD is status information, sent by the drive to the master station.

ABB drives profile (EFB) Status word, parameter 5320 EFB PAR 20			
Bit	**Name**	**Value**	**STATE/Description (Correspond to states/boxes in the state diagram)**
0	RDY-ON	1	READY TO SWITCH ON
		0	NOT READY TO SWITCH ON
1	RDY_RUN	1	READY TO OPERATE
		0	OFF1 ACTIVE
2	RDY_REF	1	OPERATION ENABLED
		0	OPERATION INHIBITED
3	TRIPPED	0…1	FAULT
		0	No fault
4	OFF_2_STA	1	OFF2 inactive
		0	OFF2 ACTIVE
5	OFF_3_STA	1	OFF3 inactive
		0	OFF3 ACTIVE
6	SWC_ON_INHIB	1	SWITCH-ON INHIBIT active
		0	SWITCH-ON INHIBIT not active
7	ALARM	1	Alarm
		0	No alarm
8	AT_SETPOINT	1	OPERATING. Actual value equals (within tolerance limits) the reference value.
		0	Actual value differs from reference value (= is outside tolerance limits).
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2)
		0	Drive control location: LOCAL

ABB drives profile (EFB) Status word, parameter 5320 EFB PAR 20			
Bit	**Name**	**Value**	**STATE/Description (Correspond to states/boxes in the state diagram)**
10	ABOVE_LIMIT	1	Supervised parameter value exceeds the supervision high limit. Bit value is 1 until the supervised parameter value falls below the supervision low limit. See parameter group 32 SUPERVISION, parameter 3201 SUPERV 1 PARAM.
		0	Supervised parameter value falls below the supervision low limit. Bit value is 0 until the supervised parameter value exceeds the supervision high limit. See parameter group 32 SUPERVISION, parameter 3201 SUPERV 1 PARAM.
11	EXT CTRL LOC	1	External control location EXT2 selected
		0	External control location EXT1 selected
12	EXT RUN ENABLE	1	External Run enable signal received
		0	No external Run enable received
13 - 15	Not in use		

DCU Profile

The following tables describe the Status word content for the DCU profile.

DCU profile Status word, parameter 0303 FB STS WORD 1			
Bit	**Name**	**Value**	**Status**
0	READY	1	Drive is ready to receive start command.
		0	Drive is not ready.
1	ENABLED	1	External Run enable signal received.
		0	No external Run enable signal received.
2	STARTED	1	Drive has received start command.
		0	Drive has not received start command.
3	RUNNING	1	Drive is modulating.
		0	Drive is not modulating.
4	ZERO_SPEED	1	Drive is at zero speed.
		0	Drive has not reached zero speed.
5	ACCELERATE	1	Drive is accelerating.
		0	Drive is not accelerating.
6	DECELERATE	1	Drive is decelerating.
		0	Drive is not decelerating.
7	AT_SETPOINT	1	Drive is at setpoint. Actual value equals reference value (ie is within tolerance limits).
		0	Drive has not reached setpoint.
8	LIMIT	1	Operation is limited by internal protection limits or group 20 LIMITS settings.
		0	Operation is within internal protection limits and according group 20 LIMITS settings.
9	SUPERVISION	1	A supervised parameter (group 32 SUPERVISION) is outside its limits.
		0	All supervised parameters are within limits.
10	REV_REF	1	Drive reference is in reverse direction.
		0	Drive reference is in forward direction.
11	REV_ACT	1	Drive is running in reverse direction.
		0	Drive is running in forward direction.
12	PANEL_LOCAL	1	Control is in keypad (or PC tool) local mode.
		0	Control is not in keypad local mode.
13	FIELDBUS_LOCAL	1	Control is in fieldbus local mode
		0	Control is not in fieldbus local mode.
14	EXT2_ACT	1	Control is in EXT2 mode.
		0	Control is in EXT1 mode.
15	FAULT	1	Drive is in a fault state.
		0	1 0 Drive is not in a fault state.

DCU profile Status word, parameter 0304 FB STS WORD 2			
Bit	**Name**	**Value**	**Status**
16	ALARM	1	An alarm is on.
		0	No alarms are on.
17	NOTICE	1	A maintenance request is pending.
		0	No maintenance request
18	DIRLOCK	1	Direction lock is ON. (Direction change is locked.)
		0	Direction lock is OFF.
19	LOCALLOCK	1	Local mode lock is ON. (Local mode is locked.)
		0	Local mode lock is OFF
20	CTL_MODE	1	1 Drive is in vector control mode.
		0	0 Drive is in scalar control mode.
21	JOGGING ACTIVE	1	Jogging function is active.
		0	Jogging function is not active.
22 - 25	Reserved		
26	REQ_CTL	1	Control word requested from fieldbus
		0	No operation
27	REQ_REF1	1	Reference 1 requested from fieldbus
		0	Reference 1 is not requested from fieldbus.
28	REQ_REF2	1	Reference 2 requested from fieldbus
		0	Reference 2 is not requested from fieldbus.
29	REQ_REF2EXT	1	External PID reference 2 requested from fieldbus
		0	External PID reference 2 is not requested from fieldbus.
30	ACK_STARTINH	1	Start inhibit from fieldbus
		0	No start inhibit from fieldbus
31	Reserved		

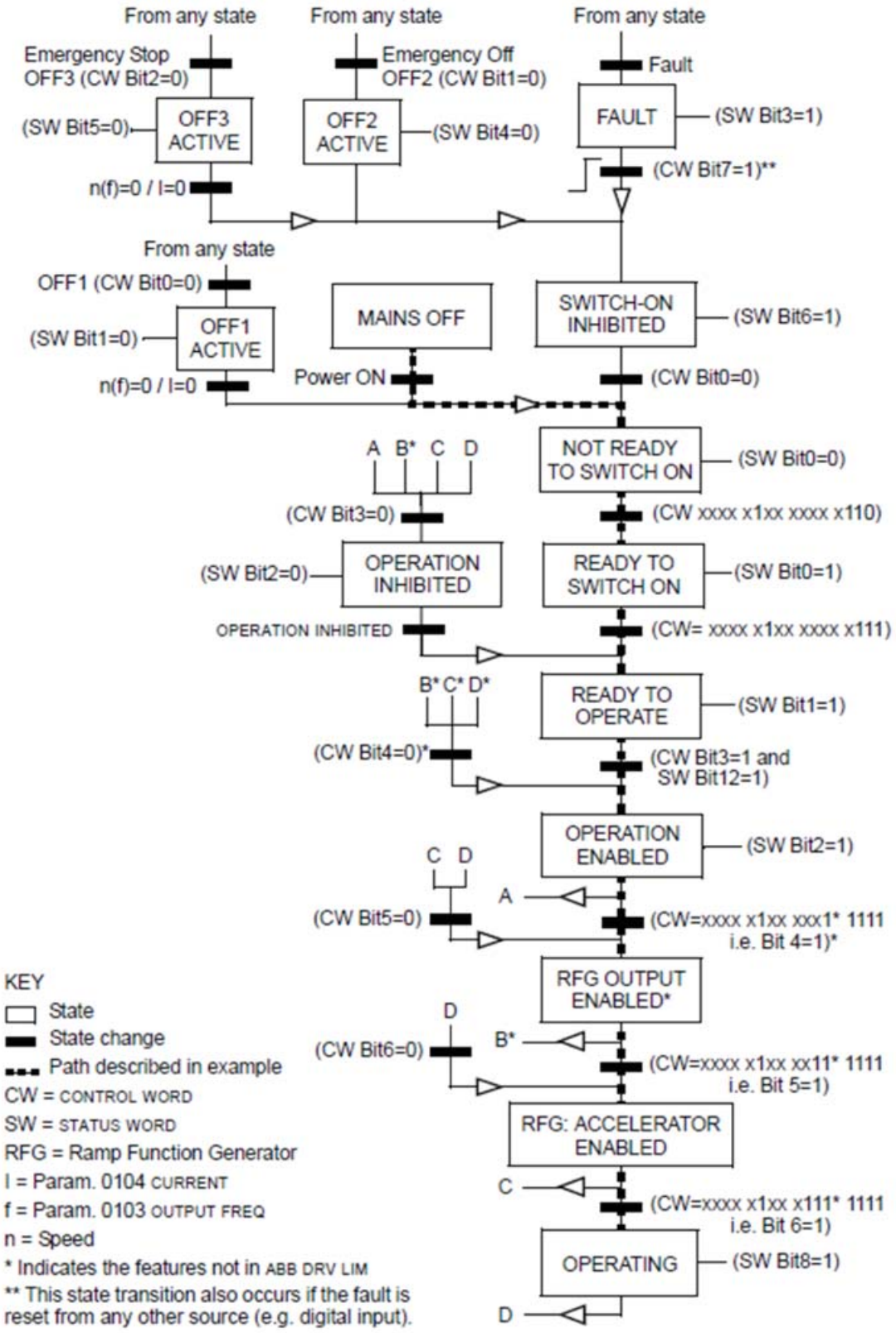
E.10.4 State diagram

ABB Drives profile
To illustrate the operation of the state diagram, the following example (ABB DRV LIM implementation of the ABB Drives profile) uses the control word to start the drive:

- First, the requirements for using the CONTROL WORD must be met. See above.
- When the power is first connected, the state of the drive is not ready to switch on. See dotted lined path ( ) in the state diagram below.
- Use the CONTROL WORD to step through the state machine states until the OPERATING state is reached, meaning that the drive is running and follows the given reference. See the table below.

Step	CONTROL WORD Value	Description
1	CW = 0000 0000 0000 0110 (Bit 15) (Bit 0)	This CW value changes the drive state to READY TO SWITCH ON.
2		Wait at least 100 ms before proceeding.
3	CW = 0000 0000 0000 0111	This CW value changes the drive state to READY TO OPERATE.
4	CW = 0000 0000 0000 1111	This CW value changes the drive state to OPERATION ENABLED. The drive starts, but will not accelerate.
5	CW = 0000 0000 0010 1111	This CW value releases the ramp function generator (RFG) output and changes the drive state to RFG: ACCELERATOR ENABLED.
6	CW = 0000 0000 0110 1111	This CW value releases the ramp function generator (RFG) output and changes the drive state to OPERATING. The drive accelerates to the given reference and follows the reference.

The state diagram below describes the start-stop function of CONTROL WORD (CW) and STATUS WORD (SW) bits for the ABB Drives profile.



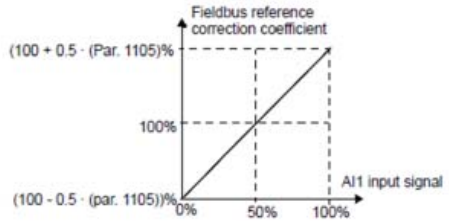
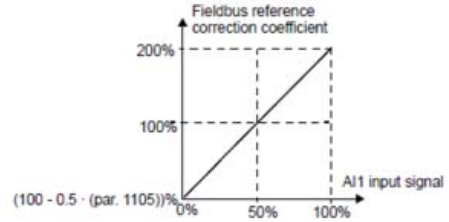
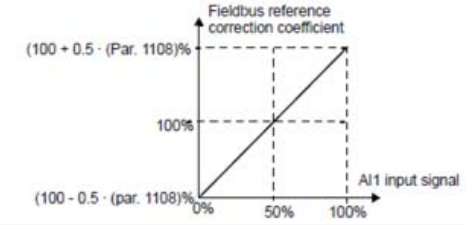
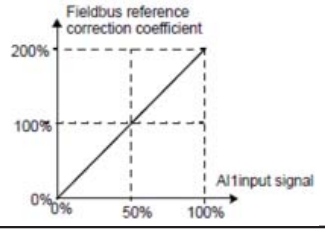
E.10.5 Reference scaling

ABB Drives and DCU profiles
The following table describes REFERENCE scaling for the ABB Drives and DCU profiles.

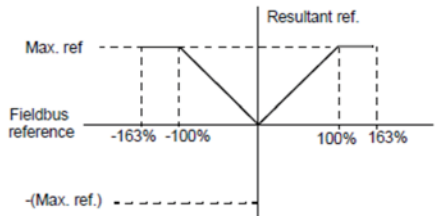
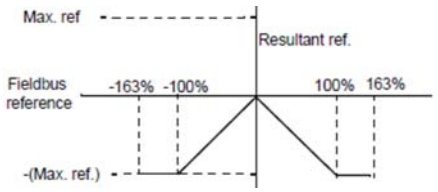
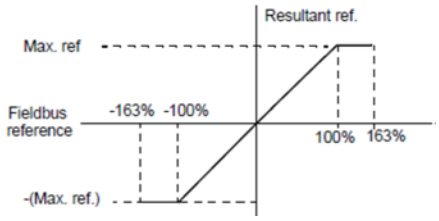
Reference	Range	Reference type	Scaling	Remarks
REF1	-32767 - +32767	Speed or frequency	-20000 = -(par. 1105) 0 = 0 +20000 = (par. 1105) (20000 corresponds to 100%)	Final reference limited by 1104/1105. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency).
REF2	-32767 - +32767	Speed or frequency	-10000 = -(par. 1108) 0 = 0 +10000 = (par. 1108) (10000 corresponds to 100%)	Final reference limited by 1107/1108. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency).
		Torque	-10000 = -(par. 1108) 0 = 0 +10000 = (par. 1108) (10000 corresponds to 100%)	Final reference limited by 2015/2017 (torque 1) or 2016/2018 (torque 2).
		PID reference	-10000 = -(par. 1108) 0 = 0 +10000 = (par. 1108) (10000 corresponds to 100%)	Final reference limited by 4012/4013 (PID set 1) or 4112/4113 (PID set 2).

Note: The setting of parameter 1104 REF1 MIN and 1107 REF2 MIN has no effect on the scaling of references.

When parameter 1103 REF1 SELECT or 1106 REF2 SELECT is set to COMM+AI1 or COMM*AI1, the reference is scaled as follows:

ABB Drives and DCU Profiles		
Reference	**Value Setting**	**AI Reference Scaling**
REF1	COMMM+AI1	COMM(%) + (AI(%) - 0.5 · REF1 MAX (%)) 
REF1	COMM·AI1	COMM(%) · (AI(%) / 0.5 · REF1 MAX (%)) 
REF2	COMM+AI1	COMM(%) + (AI(%) - 0.5 · REF2 MAX (%)) 
REF2	COMM·AI1	COMM(%) · (AI(%) / 0.5 · REF2 MAX (%)) 

Reference handling
Use START/STOP/DIR parameters to configure for control of rotation direction for each control location (EXT1 and EXT2). The following diagrams illustrate how group 10 parameters and the sign of the fieldbus reference interact to produce REFERENCE values (REF1 and REF2). Note, fieldbus references are bipolar, that is they can be positive or negative.

ABB Drives and DCU Profiles		
Reference	**Value Setting**	**AI Reference Scaling**
1003 DIRECTION	1 (FORWARD)	
1003 DIRECTION	2 (REVERSE)	
1003 DIRECTION	3 (REQUEST)	

E.11 Fieldbus Adapter

As mentioned earlier in this Appendix, two basic serial communications configurations are available:
- embedded fieldbus (EFB)
- fieldbus adapter (FBA) - With one of the optional FBA modules in the drive's expansion slot 2, the drive can communicate to a control system using one of the following protocols:
  - PROFIBUS DP
  - Ethernet (Modbus/TCP, Ethernet/IP™, EtherCAT, PROFINET 10, POWERLINK)
  - CANopen
  - DeviceNet™
  - ControlNet™

The ACB530 detects automatically which communication protocol is used by the plug-in fieldbus adapter. The default settings for each protocol assume that the profile used is the protocol's industry-standard drive profile (e.g. PROFIdrive for PROFIBUS, AC/DC Drive for DeviceNet). All of the FBA protocols can also be configured for the ABB Drives profile. Configuration details depend on the protocol and profile used.These details are provided in a user's manual supplied with the FBA module.

E.11.1 Control interface

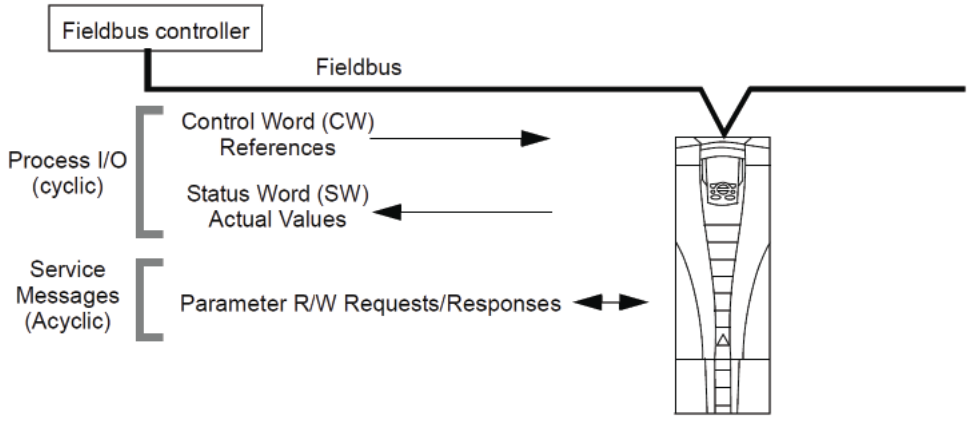
In general, the basic control interface between the fieldbus system and the drive consists of:

- Output Words:
  – CONTROL WORD
  – REFERENCE (speed or frequency)
  – Others: The drive supports a maximum of 15 output words. Protocols limits may further restrict the total.

- Input Words:
  – STATUS WORD
  – Actual Value (speed or frequency)
  – Others: The drive supports a maximum of 15 input words. Protocols limits may further restrict the total.

Note: The words "output" and "input" are used as seen from the fieldbus controller point of view. For example an output describes data flow from the fieldbus controller to the drive and appears as an input from the drive point of view.

The meanings of the controller interface words are not restricted by the ACB530. However, the profile used may set particular meanings.



E.11.2 Control Word

The CONTROL WORD is the principal means for controlling the drive from a fieldbus system. The fieldbus controller sends the CONTROL WORD to the drive. The drive switches between states according to the bit-coded instructions in the CONTROL WORD. Using the CONTROL WORD requires that:

- The drive is in remote (REM) control.
- The serial communication channel is defined as the source for controlling commands from EXT1 (set using parameters 1001 EXT1 COMMANDS and 1102 EXT1/EXT2 SEL).
- The external plug-in fieldbus adapter is activated:
  – Parameter 9802 COMM PROT SEL = 4 (EXT FBA).
  – The external plug-in fieldbus adapter is configured to use the drive profile mode or drive profile objects.

The content of the CONTROL WORD depends on the protocol/profile used.

Status Word

The STATUS WORD is a 16-bit word containing status information, sent by the drive to the fieldbus controller. The content of the STATUS WORD depends on the protocol/profile used.

Reference

The contents of each REFERENCE word:

- can be used, as speed or frequency reference
- is a 16-bit word comprised of a sign bit and a 15-bit integer
- Negative references (indicating reversed rotation direction) are indicated by the two's complement of the corresponding positive reference value.

The use of a second reference (REF2) is supported only when a protocol is configured for the ABB Drives profile.

Reference scaling is fieldbus type specific. See the user's manual provided with the FBA module.

Actual Values

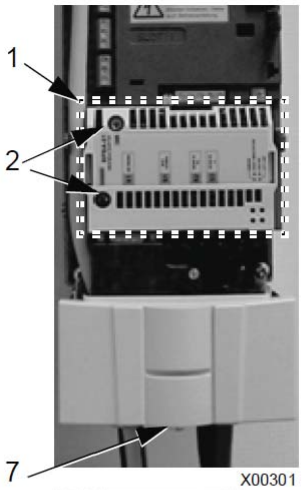
Actual Values are 16-bit words containing information on selected operations of the drive. Drive Actual Values (for example, START/STOP/DIR parameters) can be mapped to Input Words using Group 51: EXT COMM MODULE parameters (protocol-dependent, but typically parameters 5104…5126).

E.12 Mechanical and Electrical Installation - FBA

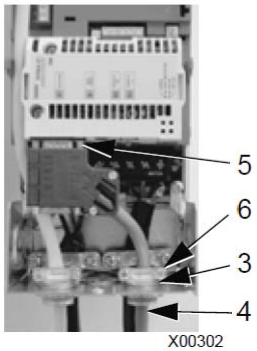
WARNING! Connections should be made only while the drive is disconnected from the power source.

Overview
The FBA (fieldbus adapter) is a plug-in module that fits in the drive's expansion slot 2. The module is held in place with plastic retaining clips and two screws. The screws also ground the shield for the module cable and connect the module GND signals to the drive control board.

On installation of the module, electrical connection to the drive is automatically established through the 34-pin connector.



X00301



X00302

Mounting procedure

Note: Install the input power and motor cables first.
1. Insert the module carefully into the drive expansion slot 2 until the retaining clips lock the module into position.
2. Fasten the two screws (included) to the stand-offs. **Note**: Correct installation of the screws is essential for fulfilling the EMC requirements and for proper operation of the module.
3. Open the appropriate knockout in the conduit box and install the cable clamp for the network cable.
4. Route the network cable through the cable clamp.
5. Connect the network cable to the module's network connector.
6. Tighten the cable clamp.
7. Install the conduit box cover (1 screw).
8. For configuration information see the protocol specific documentation provided with the module.

E.13 Communication Set-up - FBA

Serial communication selection
To activate the serial communication, use parameter 9802 COMM PROT SEL. Set 9802 = 4 (EXT FBA).

Serial communication configuration
Setting 9802, together with mounting a particular FBA module, automatically sets the appropriate default values in parameters that define the communication process. These parameters and descriptions are defined in the user's manual supplied with the FBA module.
- Parameter 5101 is automatically configured.
- Parameters 5102…5126 are protocol-dependent and define, for example, the profile used and additional I/O words. These parameters are referred to as the fieldbus configuration parameters. See the user's manual provided with the FBA module for details on the fieldbus configuration parameters.
- Parameter 5127 forces the validation of changes to parameters 5102…5126. If parameter 5127 is not used, changes to parameters 5102…5126 take affect only after the drive power is cycled.
- Parameters 5128…5133 provide data about the FBA module currently installed (e.g. component versions and status).

E.14 Activate Drive Control Functions – FBA

Fieldbus control of various drive functions requires configuration to:
- tell the drive to accept fieldbus control of the function
- define as a fieldbus input, any drive data required for control
- define as a fieldbus output, any control data required by the drive.

The following sections describe, at a general level, the configuration required for each control function. The last column in each table below is deliberately blank. See the user's manual supplied with the FBA module for the appropriate entry.

E.14.1 Start/Stop Direction control

Using the fieldbus for start/stop/direction control of the drive requires:
- drive parameter values set as defined below
- fieldbus controller supplied command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive Parameter		Value	Description	Protocol Reference
1001	EXT1 COMMANDS	10 (COMM)	Start/Stop controlled by fieldbus with EXT1 selected.	
1002	EXT2 COMMANDS	10 (COMM)	Start/Stop by controlled fieldbus with Ext2 selected.	
1003	DIRECTION	3 (REQUEST)	Direction controlled by fieldbus.	

E.14.2 Input reference select

Using the fieldbus to provide input reference to the drive requires:
- drive parameter value set as defined below
- fieldbus controller supplied reference word(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive Parameter		Value	Description	Protocol Reference
1102	EXT1/EXT2 SEL	8 (COMM)	Ref. selected by fieldbus. (Required only if 2 references used.)	
1103	REF1 SELECT	8 (COMM) 9 COMM+AI1) 10 (COMM*AI1)	Input reference 1supplied by fieldbus.	
1106	REF2 SELECT	8 (COMM) 9 COMM+AI1) 10 (COMM*AI1)	Input reference 2 supplied by fieldbus. (Required only if 2 references used.)	

NOTE: Multiple references are supported only when using the ABB Drives profile.
NOTE: Scaling - Where required, REFERENCES can be scaled.

E.14.3 System control

Using the fieldbus for miscellaneous drive control requires:
- drive parameter values set as defined below
- fieldbus controller command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive Parameter		Value	Description	Protocol Reference
1601	RUN ENABLE	7 (COMM)	Run enable by fieldbus.	
1604	FAULT RESET SEL	8 (COMM)	Fault reset by fieldbus.	
1607	PARAM SAVE	1 (SAVE)	Saves altered parameters to memory (then value returns to 0).	

E.14.4 Relay output control

Using the fieldbus for relay output control requires:
- drive parameter values set as defined below
- fieldbus controller command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive Parameter		Value	Description	Protocol Reference
1401	RELAY OUTPUT 1	35 (COMM) 36 (COMM (-1))	Relay Output 1 controlled by fieldbus.	
1402	RELAY OUTPUT 2		Relay Output 2 controlled by fieldbus.	
1403	RELAY OUTPUT 3		Relay Output 3 controlled by fieldbus.	
1410[1]	RELAY OUTPUT 4		Relay Output 4 controlled by fieldbus.	
1411[1]	RELAY OUTPUT 5		Relay Output 5 controlled by fieldbus.	
1412[1]	RELAY OUTPUT 6		Relay Output 6 controlled by fieldbus.	

1. More than 3 relays requires the addition of a relay extension module.

Note: Relay status feedback occurs without configuration as defined below.

Drive Parameter		Value	Protocol Reference
0122	RO 1-3 STATUS	Relay 1-3 status.	
0123	RO 4-6 STATUS	Relay 4-6 status.	

E.14.5 Analog output control

Using the fieldbus for analog output control (e.g. PID setpoint) requires:
- drive parameter values set as defined below
- fieldbus controller command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

Drive Parameter		Value	Description	Protocol Reference
1501	AO1 CONTENT SEL	135 (COMM)	Analog Output 1 controlled by writing to parameter 0135.	-
0135	COMM VALUE 1	-		
1502 - 1505	AO1 CONTENT MIN - MAXIMUM AO1	Set appropriate values.	Used for scaling.	-
1506	FILTER AO1		Filter time constant for AO1.	-
1507	AO2 CONTENT SEL	136 (COMM)	Analog Output 2 controlled by writing to parameter 0136.	-
0136	COMM VALUE 2	-		
1508 - 1511	AO2 CONTENT MIN - MAXIMUM AO2	Set appropriate values.	Used for scaling.	-
1512	FILTER AO2		Filter time constant for AO2.	-

E.14.6 PID Control setpoint source

Using the following settings to select the fieldbus as the setpoint source for PID loops:

Drive Parameter		Value	Description	Protocol Reference
4010	SET POINT SEL (Set 1)	8 (COMM VALUE 1) 9 (COMM+AI1) 10 (COMM*AI1)	Setpoint is input reference 2 (+/-/* AI1)	
4110	SET POINT SEL (Set 2)			
4210	SET POINT SEL (Ext/Trim)			

E.14.7 Communication fault

When using fieldbus control, specify the drive's action if serial communication is lost.

Drive Parameter		Value	Description
3018	COMM FAULT FUNC	0 (NOT SEL) 1 (FAULT) 2 (CONST SP7) 3 (LAST SPEED)	Set for appropriate drive response.
3019	COMM FAULT TIME		

E.15 Feedback from the Drive - FBA

Inputs to the controller (drive outputs) have pre-defined meanings established by the protocol. This feedback does not require drive configuration. The following table lists a sample of feedback data.

Drive Parameter		Protocol Reference
0102	SPEED	
0103	OUTPUT FREQ	
0104	CURRENT	
0105	TORQUE	
0106	POWER	
0107	DC BUS VOLTAGE	
0109	OUTPUT VOLTAGE	
0301	FB CMD WORD1 - bit 0 (STOP)	
0301	FB CMD WORD1 1 - bit 2 (REV)	
0118	DI 1-3 STATUS - bit 0 (DI3)	

E.16 Diagnostics

E.16.1 Fault handling

The ACB530 provides fault information as follows:
- The control panel display shows a fault code and text.
- Parameters 0401 LAST FAULT, 0412 PREVIOUS FAULT1 and 0413 PREVIOUS FAULT2 store the most recent faults.
- For fieldbus access, the drive reports faults as a hexadecimal value, assigned and coded according to the DRIVECOM specification. See the table below. Not all profiles support requesting fault codes using this specification. For profiles that support this specification, the profile documentation defines the proper fault request process.

Drive Fault Code		Fieldbus Fault Code (DRIVECOM specification)
1	OVERCURRENT	2310h
2	DC CURRENT	3210h
3	DEV OVERTEMP	4210h
4	SHORT CIRC	2340h
5	Reserved	FF6Bh
6	DC UNDERVOLT	3220h
7	AI1 LOSS	8110h
8	AI2 LOSS	8110h
9	MOT OVERTEMP	4310h
10	PANEL LOSS	5300h
11	ID RUN FAIL	FF84h
12	MOTOR STALL	7121h
14	EXT FAULT 1	9000h
15	EXT FAULT 2	9001h
16	EARTH FAULT	2330h
17	Obsolete	FF6Ah

Drive Fault Code		Fieldbus Fault Code (DRIVECOM specification)
18	THERM FAIL	5210h
19	OPEX LINK	7500h
20	OPEX PWR	5414h
21	CURR MEAS	2211h
22	SUPPLY PHASE	3130h
23	ENCODER ERR	7301h
24	OVERSPEED	7310h
25	Reserved	FF80h
26	DRIVE ID	5400h
27	CONFIG FILE	630Fh
28	SERIAL 1 ERR	7510h
29	EFB CON FILE	6306h
30	FORCE TRIP	FF90h
31	EFB 1	FF92h
32	EFB 2	FF93h
33	EFB 3	FF94h
34	MOTOR PHASE	FF56h
35	OUTP WIRING	FF95h
36	INCOMPATIBLE SW	630Fh
37	CB OVERTEMP	4110h
38	USER LOAD CURVE	FF6Bh
101	SERF CORRUPT	FF55h
102	Reserved	FF55h
103	SERF MACRO	FF55h
104	Reserved	FF55h
105	Reserved	FF55h
201	DSP T1 OVERLOAD	6100h
202	DSP T2 OVERLOAD	6100h
203	DSP T3 OVERLOAD	6100h
204	DSP STACK ERROR	6100h
205	Reserved (obsolete)	5000h
206	CB ID ERROR	5000h
207	EFB LOAD ERROR	6100h
1000	PAR HZRPM	6320h
1001	PAR PFC REF NEG	6320h
1002	Reserved (obsolete)	6320h
1003	PAR AI SCALE	6320h
1004	PAR AO SCALE	6320h
1005	PAR PCU 2	6320h
1006	PAR EXT RO	6320h
1007	PAR FIELDBUS MISSING	6320h
1008	PAR PFC MODE	6320h
1009	PAR PCU 1	6320h
1012	PAR PFC IO 1	6320h
1013	PAR PFC IO 2	6320h
1014	PAR PFC IO3	6320h
1015	PAR USER LOAD C	6320h

E.16.2 Serial Communications Diagnostics

The FBA has diagnostic tools in addition to the drive fault codes. Refer to the user manual shipped with the FBA module.

E.17 ABB Drives Profile Technical Data

E.17.1 Overview

The ABB Drives profile provides a standard profile that can be used on multiple protocols, including protocols available on the FBA module. This section describes the ABB Drives profile implemented for FBA modules.

E.17.2 Control Word

As described earlier, the CONTROL WORD is the principal means for controlling the drive from a fieldbus system. The following table and the state diagram (shown later) describe the CONTROL WORD content for the ABB Drives profile.

ABB Drives Profile (FBA) CONTROL WORD				
Bit	**Name**	**Value**	**Commanded State**	**Comments**
0	OFF1 CONTROL	1	READY TO OPERATE	Enter READY TO OPERATE.
		0	EMERGENCY OFF	Drive ramps to stop according to currently active deceleration ramp (2203 or 2205). Normal command sequence: • Enter OFF1 ACTIVE • Proceed to READY TO SWITCH ON, unless other interlocks (OFF2, OFF3) are active.
1	OFF2 CONTROL	1	OPERATING	Continue operation (OFF2 inactive).
		0	EMERGENCY OFF	Drive coasts to stop. Normal command sequence: • Enter OFF2 ACTIVE • Proceed to SWITCHON INHIBITED
2	OFF3 CONTROL	1	OPERATING	Continue operation (OFF3 inactive).
		0	EMERGENCY STOP	Drive stops within time specified by parameter 2208. Normal command sequence: • Enter OFF3 ACTIVE • Proceed to SWITCH ON INHIBITED **WARNING! Ensure motor and driven machine can be stopped using this stop mode.**
3	INHIBIT OPERATION	1	OPERATION ENABLED	Enter OPERATION ENABLED. (Note: The Run enable signal must be active; see parameter 1601. If par. 1601 is set to COMM, this bit also activates the Run enable signal.)
		0	OPERATION INHIBITED	Inhibit operation. Enter OPERATION INHIBITED.
4	Note: Bit 4 is supported only by ABB DRV FULL profile.			
	RAMP_OUT_ ZERO (ABB DRV FULL)	1	NORMAL OPERATION	Enter RAMP FUNCTION GENERATOR: ACCELERATION ENABLED.
		0	RFG OUT ZERO	Force Ramp function generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	RFG OUT ENABLED	Enable ramp function. Enter RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED.
		0	RFG OUT HOLD	Halt ramping (Ramp function generator output held).
6	RAMP_IN_ ZERO	1	RFG INPUT ENABLED	Normal operation. Enter OPERATING.
		0	RFG INPUT ZERO	Force Ramp function generator input to zero.
7	RESET	0=>1	RESET	Fault reset if an active fault exists. Enter SWITCH-ON INHIBITED. Effective if par. 1604 is set to COMM.
		0	OPERATING	Continue normal operation.
8 - 9	Not in use			
10	Note: Bit 10 is supported only by ABB DRV FULL.			
	REMOTE_CMD (ABB DRV FULL)	1		Fieldbus control enabled.
		0		• Control word ≠ 0 or reference ≠ 0: Retain last Control word and reference. • Control word = 0 and reference = 0: Fieldbus control enabled. • Reference decceleration/acceleration ramp are locked
11	EXT CTRL LOC	1	EXT2 SELECT	Select external control location EXT2. Effective if par. 1102 is set to COMM.
		0	EXT1 SELECT	0 Select external control location EXT1. Effective if par. 1102 is set to COMM.
12 - 15	Not in use			

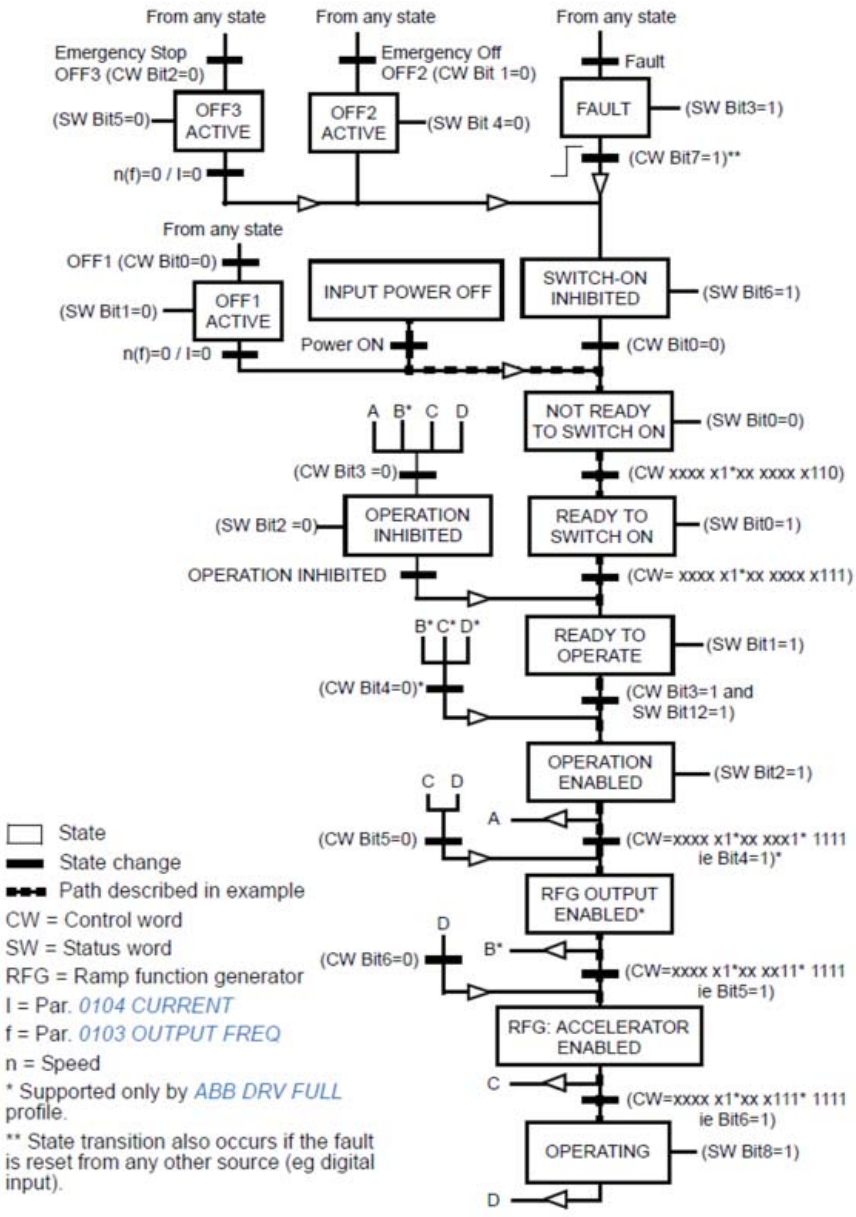
E.17.3 Status Word

As described earlier, the contents of the STATUS WORD is status information, sent by the drive to the master station. The following table and the state diagram later in this sub-section describe the status word content.

ABB Drives Profile (FBA) STATUS WORD			
Bit	**Name**	**Value**	**STATE/Description (Correspond to states/boxes in the state diagram)**
0	RDY-ON	1	READY TO SWITCH ON
		0	NOT READY TO SWITCH ON
1	RDY_RUN	1	READY TO OPERATE
		0	OFF1 ACTIVE
2	RDY_REF	1	OPERATION ENABLED
		0	OPERATION INHIBITED
3	TRIPPED	0…1	FAULT
		0	No fault
4	OFF_2_STA	1	OFF2 inactive
		0	OFF2 ACTIVE
5	OFF_3_STA	1	OFF3 inactive
		0	OFF3 ACTIVE
6	SWC_ON_INHIB	1	SWITCH-ON INHIBITED
		0	Switch-on inhibit not active
7	ALARM	1	Alarm
		0	No alarm
8	AT_SETPOINT	1	OPERATING. Actual value equals (within tolerance limits) the reference value.
		0	Actual value differs from reference value (= is outside tolerance limits).
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2)
		0	Drive control location: LOCAL
10	ABOVE_LIMIT	1	Supervised parameter value exceeds the supervision high limit. Bit value is 1 until the supervised parameter value falls below the supervision low limit.
		0	Supervised parameter value falls below the supervision low limit. Bit value is 0 until the supervised parameter value exceeds the supervision high limit.
11	EXT CTRL LOC	1	External control location EXT2 selected
		0	External control location EXT1 selected
12	EXT RUN ENABLE	1	External Run enable signal received
		0	No external Run enable received
13-15	Not in use		

E.17.4 State diagram

The state diagram below describes the start-stop function of Control word (CW) and Status word (SW) bits for the ABB drives profile.



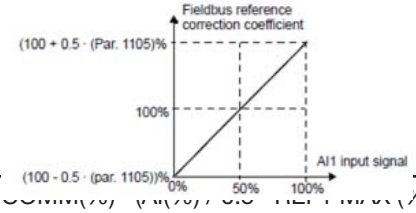
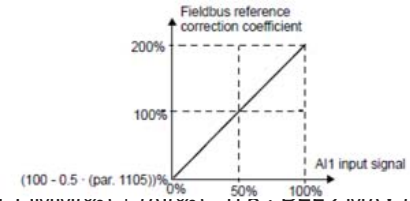
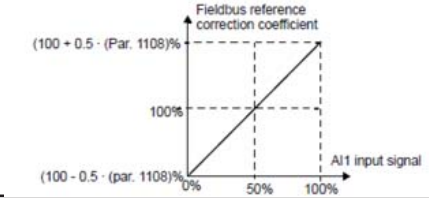
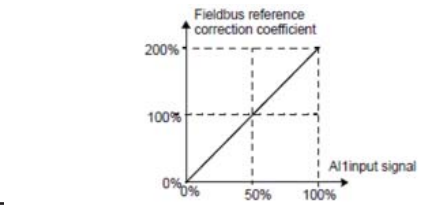
E.17.5 Reference Scaling

Fieldbus references REF1 and REF2 are scaled for the Baldor drives profile as shown in the following table.

Reference	Range	Reference type	Scaling	Remarks
REF1	-32767 - +32767	Speed or frequency	-20000 = -(par. 1105) 0 = 0 +20000 = (par. 1105) (20000 corresponds to 100%)	Final reference limited by 1104/1105. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency).
REF2	-32767 - +32767	Speed or frequency	-10000 = -(par. 1108) 0 = 0 +10000 = (par. 1108) (10000 corresponds to 100%)	Final reference limited by 1107/1108. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency).
		Torque	-10000 = -(par. 1108) 0 = 0 +10000 = (par. 1108) (10000 corresponds to 100%)	Final reference limited by 2015/2017 (torque 1) or 2016/2018 (torque 2).
		PID reference	-10000 = -(par. 1108) 0 = 0 +10000 = (par. 1108) (10000 corresponds to 100%)	Final reference limited by 4012/4013 (PID set 1) or 4112/4113 (PID set 2).

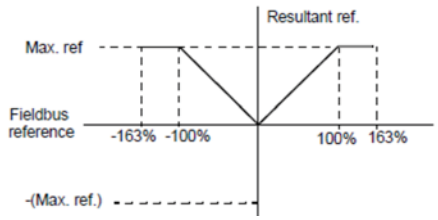
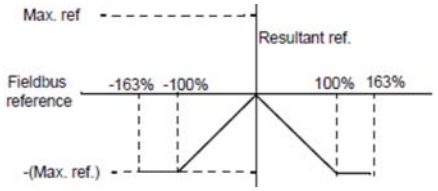
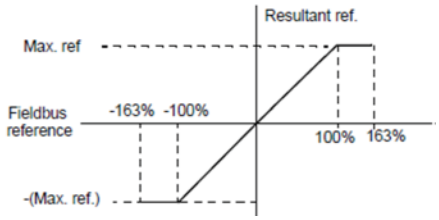
Note: The setting of parameter 1104 REF1 MIN and 1107 REF2 MIN has no effect on the scaling of references.

When parameter 1103 REF1 SELECT or 1106 REF2 SELECT is set to COMM+AI1 or COMM*AI1, the reference is scaled as follows:

ABB Drives and DCU Profiles		
Reference	**Value Setting**	**AI Reference Scaling**
REF1	COMMM+AI1	COMM(%) + (AI(%) - 0.5 · REF1 MAX (%)) 
REF1	COMM·AI1	COMM(%) · (AI(%) / 0.5 · REF1 MAX (%)) 
REF2	COMM+AI1	COMM(%) + (AI(%) - 0.5 · REF2 MAX (%)) 
REF2	COMM·AI1	COMM(%) · (AI(%) / 0.5 · REF2 MAX (%)) 

Reference handling

Use START/STOP/DIR parameters to configure for control of rotation direction for each control location (EXT1 and EXT2). The following diagrams illustrate how parameters and the sign of the fieldbus reference interact to produce REFERENCE values (REF1 and REF2). Note, fieldbus references are bipolar, that is they can be positive or negative.

ABB Drives Profile		
Reference	**Value Setting**	**AI Reference Scaling**
1003 DIRECTION	1 (FORWARD)	
1003 DIRECTION	2 (REVERSE)	
1003 DIRECTION	3 (REQUEST)	

E.17.6 Actual Value Scaling

The scaling of the integers sent to the fieldbus as Actual Values depends on the resolution of the selected drive parameter. Except as noted for ACT1 and ACT2 below, scale the feedback integer using the resolution listed for the parameter in section. For example

Feedback Integer	Parameter Resolution	Scaled Value
1	0.1 mA	1 • 0.1 mA = 0.1 mA
10	0.1%	10 • 0.1% = 1%

Data words 5 and 6 are scaled as follows:

	Contents	Scaling
ACT1	ACTUAL SPEED	-20000 … +20000 = -(par. 1105) … +(par. 1105)
ACT2	TORQUE	-10000 … +10000 = -100% … +100%

Virtual addresses of the drive control
The virtual address area of the drive control is allocated as follows:

1	Control Word
2	Reference 1 (REF1)
3	Reference 2 (REF2)
4	Status Word
5	Actual Value 1 (ACT1)
6	Actual Value 2 (ACT2)

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